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GASOLINE LOCOMOTIVES AND CARS FOR RAILROADS.

By the English Correspondent of SCIENTIFIC AMERICAN.

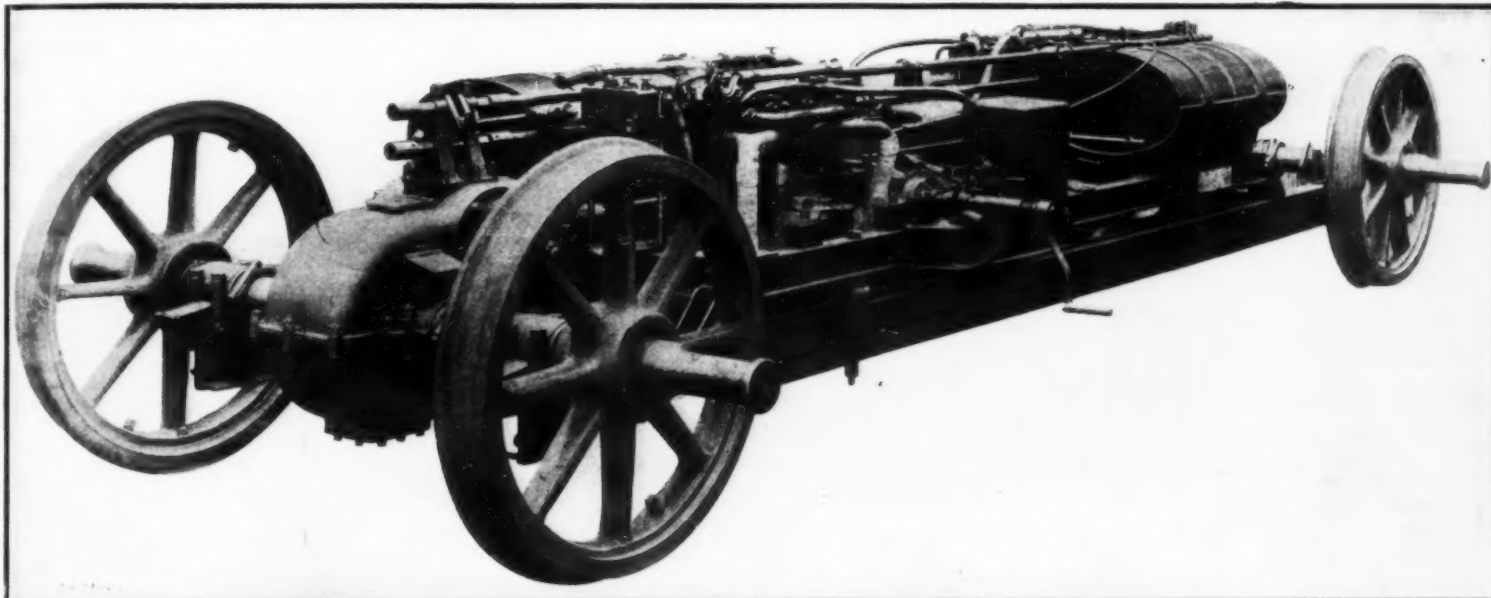
A few weeks ago we described in the pages of the SCIENTIFIC AMERICAN SUPPLEMENT an interesting application of the gasoline motor to a locomotive for the haulage of meat cars in the city of London markets at Deptford. Another interesting development in the same direction is being carried out by the Great Northern Railroad of Great Britain, only in this case, instead of utilizing a gasoline locomotive to haul a train of coaches, the car is self-contained. Many of the trunk railroads of Great Britain have initiated systems of steam propelled coaches for short-distance traffic,

while the North-Eastern Railroad has introduced a service of gasoline-electric locomotives (which we have also described) in which the 96-horse-power gasoline engine drives a Westinghouse dynamo, thus generating the necessary energy for the propulsion of the car. In the experiment carried out by the Great Northern Railroad, however, the coach is driven direct by the gasoline motors in precisely the same way as an automobile or omnibus.

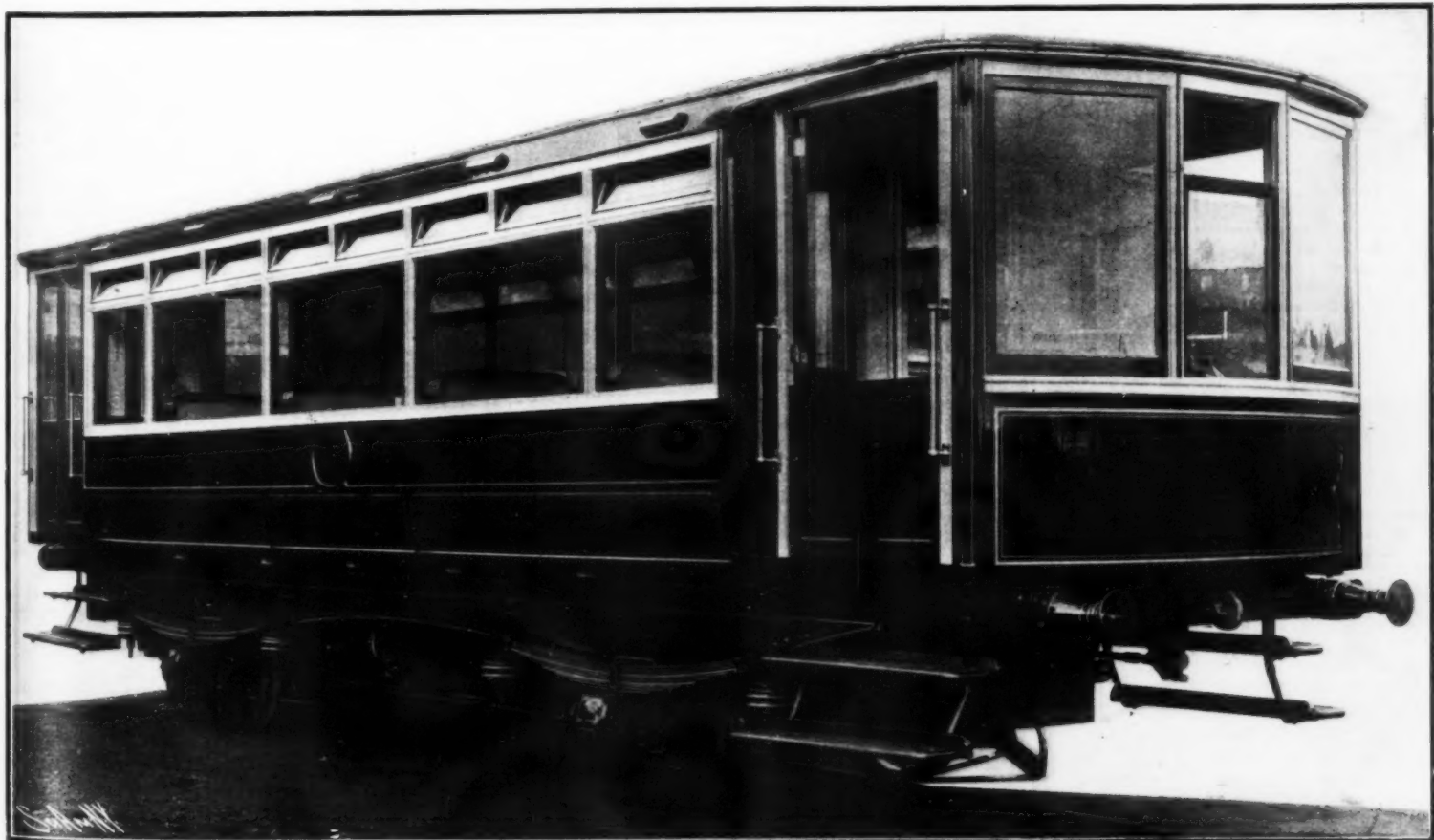
The economical operation of short branch lines traversing sparsely populated country has long been one of the most important problems of railroad management, and it is generally admitted that inefficiency of working arises from the necessity of employing steam locomotives. The ordinary steam-hauled train oper-

ates to the best advantage either over long distances or where traffic is fairly dense, but is unsatisfactory where traffic is light, for the reason that it is impossible to materially reduce the number of operators. Even under conditions which would permit the use of short trains, it has been incumbent to employ two men on the locomotive and at least one brakeman on the train. In addition to the use of a considerable amount of rolling stock for remunerative traffic, there are the stand-by losses, which are a serious matter in the case of a railroad system on which branch lines are numerous.

It is evident that under such conditions an automobile type of car presents obvious advantages. For some time past a good deal of experimental work has been carried on by various railways throughout Great Brit-



FRAME OF THE GASOLINE RAILWAY CAR, SHOWING COMPLETE MACHINERY.



A 22-PASSENGER MOTOR RAILWAY CAR PROPELLED BY TWO GASOLINE ENGINES OF 36 HORSE-POWER EACH, AND CAPABLE OF A SPEED OF 50 MILES AN HOUR.

pin to determine which type of automobile seemed best suited to their peculiar conditions. But though an automobile system immediately reduces the operating staff, and gives a greater degree of flexibility and obviates the necessity of much rolling stock lying idle, there are at the same time certain conditions which the automobile must meet, even presuming a reliable type of motor is obtained, in order to insure its successful application. It is essential that such a vehicle should deal with traffic under periods of abnormal demand, yet be capable of economical operation if traffic is light. Moreover, under some conditions it would not be sufficient that an automobile should be powerful enough to draw its own load, because there are cases where it would be an advantage for such a vehicle to be able to draw an extra coach or a freight car.

During the past few months the Great Northern Railroad has been carrying out highly interesting experiments in this direction. Probably no other railroad in England has a larger number of branch lines traversing thinly populated districts than this company, and many of these branch lines are maintained at a deficit. Yet, as a feeder to the trunk system, the short branch lines are exceedingly necessary, and under these conditions an automobile, if a satisfactory one could be devised, appeared to offer considerable advantages. In view of these circumstances the Great Northern Railroad resolved to introduce a gasoline-propelled car with which the prolonged experiments have been carried out, and which while being valuable in demonstrating the possibilities of this class of vehicle under special conditions, is also interesting on account of new features which in many respects constitute a distinct advance in this type of vehicle. The car has been specially designed under the supervision of Mr. Oliver Berry, the general manager of the railroad, and constructed by Messrs. Dick, Kerr & Co., of London. In evolving this vehicle the designers have been able to avail themselves of their prolonged experience in electric street railroad construction. The system of applying two electric motors to a surface railroad car has

though the normal speed for which it is designed is 30 miles per hour, it has on several occasions attained a speed of considerably over 50 miles. The car is lighted by electricity obtained from storage batteries, which also supply current for the ignition and magnetic clutches. The design of the complete car is such that by jacking up the body the underframe and machinery can be run out in the same manner that a truck can be taken from beneath an electric street railroad car, but, in addition to this, the frame containing the machinery can be dropped from its bearings on the axles without removing the truck from underneath the car body, so that it will be seen that the flexibility and facilities for overhauling and repairs are everything that can be desired. As has already been stated, the engines in this case are made by the Daimler Motor Company, of Coventry, who have also manufactured the greater portion of the transmission gear. The patents covering the arrangement, however, are entirely controlled by Messrs. Dick, Kerr & Co.

It is intended that this gasoline-driven coach shall be operated upon a branch line connecting Hereford with the trunk Great Northern road at Hatfield, a distance of nine miles. That it is capable of employment with equal success upon much longer systems is shown by the fact that it ran from Doncaster to London, a distance of 156 miles, under its own power.

Another interesting 3-ton light gasoline locomotive has been placed on the market by the Wolseley Tool and Motor Company, of Birmingham, England, of which we reproduce an illustration.

This engine is primarily intended for use on all kinds of light railroad tracks, surface railroads in large factories, light junction railroads, and mining and quarry equipments. The engine has a hauling capacity up to 15 tons at from 8 to 10 miles per hour, and is specially designed to attain speed quickly with its load. The advantages of such a locomotive as compared with steam are obvious. Running expenses are less, there is no visible exhaust, and by the use of a large-size muffler or exhaust box the running of the

ment of the durability and efficiency of the gearing.

No ordinary cooler is provided, but a large ballast tank is supplied and a high-speed pump on the engine keeps the cooling water circulating through the cylinder jackets. The action of the exhaust through the chimney also keeps a current of cold air circulating all around the engine.

The motor is equipped with the magneto high tension type of electric ignition as such a system is preferable to the ordinary batteries and coil.

The engine is provided with a tank sufficient to carry 10 gallons of gasoline and is provided with a convenient cover and strainer. This supplies the engine to run at full power for 10 hours. A large sand box is provided, the sand being kept dry by circulation of the warm water from the engine round it. Hand-actuated sand pipes are fitted to all four wheels. A powerful brake is fitted to each wheel and is actuated from the driver's seat by a wheel and screw arrangement. The brake blocks are all of wood and are easily adjustable when necessary.

The driver's seat is placed sidewise on the near side of the locomotive, and all the control apparatus, change-speed levers, lubricators, ignition gear, brakes, etc., are conveniently placed within easy reach. The whole of the motor is neatly cased in and provided with inspection doors on each side, and at the forward end. The exhaust is carried upward through the chimney. The weight of this locomotive in working trim with fuel is 3 tons. Under trial at the testing grounds of the manufacturers this engine gave a drawbar pull of 11 hundredweight with ease, and hauled from 20 to 25 tons.

American railroads have realized the possibilities of the gasoline engine for this class of work. The Wolseley Tool and Motor Company have also under construction for the General Electric Company of Schenectady, New York, a six-cylinder motor to develop 140 brake horse-power at 450 revolutions, using kerosene as fuel. The cylinders will each have a bore of 9 inches and a stroke of 10 inches. This engine is being constructed on similar lines to the gasoline-electric vehicles that were built by this firm for the North-Eastern Railroad of Great Britain.

This 140 brake-horse-power engine, which will weigh approximately 7 tons, is to be employed on the first of the General Electric Company's new gasoline-electric railway cars. In this particular installation a great improvement is being incorporated. Instead of the car being equipped with a battery of accumulators to assist the dynamos when starting, the dynamo has been made so as to be capable of giving the increased amount of current required for starting by itself. The main battery is thus discarded, thereby effecting a great economy in weight. A small set of accumulators are used, however, for lighting the car, and for starting the gasoline motor.

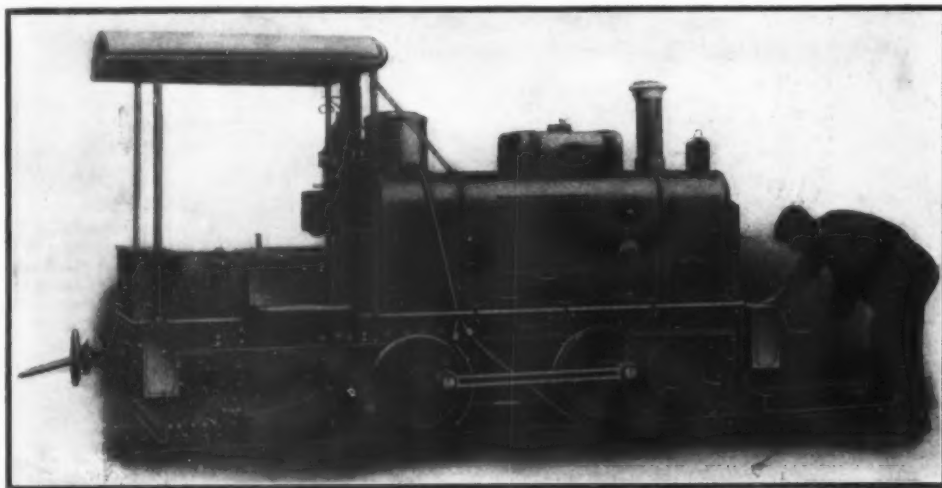
Another powerful gasoline motor for passenger traffic is in course of construction by another English firm for an American railroad. In this case the motor is to develop 200 horse-power.

NEW METHOD OF TREATING PEAT.

By the Paris Correspondent of the SCIENTIFIC AMERICAN.

CONSIDERABLE attention is being paid at present to the use of peat as fuel and the best methods of treating it, seeing that peat is found in great abundance in some parts of Europe. If we admit according to some authorities that 10 tons of freshly extracted peat correspond to 1 ton of good coal we may estimate the total value of the peat bogs of Ireland, for instance, which go down 15 to 30 feet, as representing 5 billion tons of coal. In the natural state peat is a poor combustible. Owing to its spongy texture it contains a large amount of water, and it also has a large percentage of combined water. For domestic use the pieces of peat which are taken from the bogs are simply dried in the air in piles. After this summary drying, the peat still contains some 20 or 30 per cent of water. When it is desired to work on a larger scale, mechanical presses are used which remove about one-half the water and bring the peat to a greater density. The briquettes thus formed are dried in the air or in an oven. In the latter case the amount of water is reduced to 12 per cent. For some time it has been desired to obtain a combustible from peat which should have a higher value than the briquettes above formed. Many years ago some experiments were made at Langenburg, Prussia, on a large scale for this purpose. These and other attempts were not encouraging on account of the high cost of treating the material and difficulties which were due to the elastic nature of the dried product, which acted somewhat like rubber. In considering the manufacture of briquettes we must distinguish between the simple briquettes which are made by compressing the peat, such as are now produced in Upper Bavaria, and the manufacture starting with a previously-dried product. It is this latter process which is to be considered here. One of the most recent of these methods has been brought out by the German engineer Stauber and is now applied in practice with considerable success. Before describing the new process it may be well to mention a few points about the nature and conformation of peat.

This substance is more difficult to treat than lignite, as it contains more water and also on account of its texture. Peat has not lost all of its vegetable nature. It does not undergo transformation with time, but as the layers are continually increasing in thickness, the peat undergoes a certain modification in time. It always keeps the properties which connect it with veg-



A 20-HORSE-POWER LIGHT GASOLINE LOCOMOTIVE CAPABLE OF HAULING 15 TONS AT A SPEED OF FROM 8 TO 10 MILES AN HOUR.

been adopted in the automobile, two gasoline engines being employed, which are connected to a shaft.

The car has a seating capacity for 32 passengers, but it is obvious that this can be considerably increased, and the builders are already engaged on a larger type of car, which will not only carry a considerably greater number of passengers, but will also provide a certain amount of space for baggage.

The whole of the machinery, which weighs two tons, is assembled upon a frame which is directly supported from the axles. It is thus entirely insulated from the body of the coach, with the consequence that even while standing at a station the noise and vibration from the engines are quite imperceptible to the passengers. As already indicated, following the practice now generally employed in electrically driven cars, the motive power consists of two engines, which not only minimizes the risk of breakdown but gives a better distribution of weight. The engines are not, however, connected independently to the axles, although both axles are driven, but under normal circumstances drive on to a common longitudinal shaft, which is connected to the axles by beveled gearing. To overcome the difficulty of one axle overrunning the other, owing to any possible inequality in the diameter of the wheels, a special form of differential gear is introduced, and combined with this special gear is the reversing mechanism. The engines are connected through independent clutches to a common change-speed gear box from which the power is transmitted, by means of the longitudinal driving shaft referred to above, into gear boxes suspended on each axle, and at this point the engine speed is reduced as required on the axles by means of single reduction gearing very similar to that used in the electric tramway motors.

The engines are of the standard Daimler type, each capable of developing 36 horse-power running at full speed. A separate gasoline tank is provided for each engine, and the combined capacity of these is equal to 400 car miles.

The complete car weighs something under 16 tons, including its full complement of passengers, about half the weight of the gasoline-electric vehicles, and al-

motor itself is rendered very quiet. The particular locomotive illustrated is for service upon a track of 2 feet 9½ inches gage, but this system is easily adapted to other light railroad gages.

The locomotive is fitted with a standard type Wolseley horizontal gasoline motor, developing 20 brake-horse-power at 600 revolutions per minute. There are two cylinders, side by side, of 6-inch bore and 7-inch stroke. The engine is fitted with a heavy flywheel to especially equip it for railroad traction work.

The general arrangement of this engine is on the standard lines of construction adopted by the Wolseley company for their motor car engines, with this important exception, that the engine is of very much more substantial and therefore heavier type, and the use of aluminum has been entirely eliminated. The bearings are of ample size, and every provision has been made to insure the regular running of this particular engine for a very long while. The locomotive has four driving wheels coupled, each of 18 inches diameter.

The frame of the locomotive is of stout channel steel, consisting of two longitudinal and four transverse members, stiffly braced together. The horn blocks are of cast or malleable iron, and bolted direct to the frame. These same horn blocks contain spring boxes for holding the spiral springs supporting the engine. The drive is taken from the motor by means of a Renold silent chain, one chain wheel being mounted on the crankshaft of the motor, which can be put in and out of gear by means of a conical friction clutch. The other Renold chain wheel is fixed to the outer end of the first motion shaft in the change-speed gear box. This gear has special features and is supported by nose suspension and on double bearings on the rear axle on its other end. Two speeds forward and two reverse are provided with this gear box, the speeds being approximately 3 and 8 miles per hour at normal engine speed.

The change speed is effected by means of sliding gears and a positive clutch, the final reduction in the gear box being by ordinary spur wheels. The whole gear box is very substantial and the gears are specially designed for long life and severe wear, no attempt having been made to cut down the weight to the detri-

etable substances, especially a certain elasticity when dry. This property may be attributed to the presence of hydrocarbons which contain more or less tar and form a kind of cement which unites the vegetable particles of the peat. The hydrocarbons consist of oils and tars. When the products are of a more recent formation they contain more oxygen and volatile matter along with light oils. It is the proportion of such compounds which determines the process of treatment to be adopted for reducing the raw material into briquettes. If we push the drying of the material too far we risk the chance of driving off part of the hydrocarbons, and the peat when dried no longer has enough plastic matter to form a good briquette, especially as regards cohesion. Therefore to obtain a practical process a considerable study of the conditions is necessary.

In the Stauber method, the peat is first extracted from the soil by a kind of dredger of suitable form, and is put in heaps on the ground to dry. This first operation, although it seems simple, should be carried out under proper conditions as regards the influence it will have upon the succeeding operations. The peat which has thus been dried is transported upon dumping carts having one-half cubic yard capacity and unloaded into pits from whence a conveyor takes it up to the compressing apparatus. The latter is formed of a band of wire-gauze of large mesh which passes under two rollers. The latter press the peat against the gauze and the water is squeezed out below. At the end of the band, which is 5 feet wide and 15 feet long, an endless chain provided with scrapers causes the compressed peat to fall upon a kind of sieve shaker, which separates it. The larger pieces are treated over again, and their proportion should be as small as possible. The fibers and vegetable matter which adhere to the wire-gauze are detached by a revolving brush which runs below it. The crumbled peat is brought to a drying oven by a vertical conveyor. It is broken into small pieces in a special apparatus as it passes along.

The drying oven is one of the essential features of the Stauber process. The material is put into a metal drum 5 feet in diameter and 25 feet long which is placed horizontally on rollers. The cylinder is rotated and a spiral inside it is used to give an advance movement to the peat, which is dried by hot gases from a furnace. A 50-horse-power engine drives the cylinder. One ton of raw peat is reduced to $\frac{1}{4}$ ton after drying, containing some 100 pounds of water. The dried material is then run between a set of crushing rollers which compress it, and then is brought by a vertical conveyor upon a sieve with 0.12 inch mesh which separates the vegetable matter, stone, sand, etc., which might remain and would injure the quality of the briquettes. The matter which is thus cleaned is taken once more by a conveyor into a hopper which feeds the briquette press. The latter is built on the Exter system and is run by a 60-horse-power engine. In 24 hours with two gangs of men working ten hours each they can turn out five carloads of briquettes, supposing 100 strokes of the press per minute. The briquette weighs 0.45 kilogramme (1 pound) and we have 2.7 tons per hour or 50 tons per day of 20 hours. This 50 tons represents a volume of peat equal to 260 cubic yards. As to the cost of manufacture, this is said to be very reasonable with the above process.

TOILET SPECIALTIES.

This is a modest title for an article which has a curious history. The writer is a chemist who has had wide experience in the United Kingdom and the United States. He found himself not long ago in the factory of a celebrated American skin or toilet specialist who makes, or made, "health, youth, and beauty" his business maxim. The factory was a sort of garret in which there were exactly twenty-two stock bottles (largest, half a gallon) and half a dozen pots of materials for the specialties; one chemist to do the compounding; three women to do the wrapping, and two persons to look on. The "specialist" got his knowledge from the chemists whom he has employed from time to time, and who whipped his formulae into shape. The preparations have been extensively advertised, and have quite a sale in department stores, for do not Mrs. Lillie Langtry, Millie James, Cecilia Loftus, Katherine Grey, Bonnie Magin, and dozens more "prominent artists use, indorse, and recommend them"? If they do not, the skin specialist says they do.

We begin with the specialist's prescriptions, and add some other formulae which are in use by leading American drug stores:

Face Powder Base.

White talcum 8 lbs.
Fine kaolin 4 lbs.
Mix.

Flesh Face-Powder.

Base 9 lbs.
Powdered Florentine orris 1 lb.
Carmin No. 40 250 gr.
Extract of jasmin 100 minims
Oil of neroli 20 minims
Vanillin 5 gr.
Artificial musk 30 gr.
White heliotropin 30 gr.
Cumarin 1 gr.

Rub the carmine with a portion of the base and alcohol in a mortar, mixing the perfume the same way in another large mortar and adding the orris. Mix and sift all until specks of carmine disappear on rubbing.

Brunette or Rachelle.

Base 9 lbs.
Powdered Florentine orris 1 lb.
Perfume the same.
Powdered yellow ochre 3 oz. 120 gr. (av.)
Carmin No. 40 60 gr.

Rub down the carmine and ochre with alcohol in a mortar, and spread on glass to dry; then mix and sift.

White Face Powder.

Base 9 lbs.
Powdered Florentine orris 1 lb.

Perfume the same. Mix and sift.

Liquid Rouge (Peach Tint).

Solution No. 1.

Buffalo eosine dr. iv.
Distilled water oz. xvij.
Mix.

Acid Solution No. 2.

Pure hydrochloric acid dr. iiss.
Distilled water oz. lxiij.
Mix.

Pour No. 1 solution into No. 2, shake, and set aside for a few hours; then pour off the clear portion and collect the precipitate on a filter. Wash with the same amount of No. 2 and immediately throw the precipitate into a glass measure, stirring in with a glass rod sufficient of No. 2 to measure 16 ounces in all. Pass through a hair sieve to get out any filtering paper. To every 16 ounces add 8 ounces of glycerin.

Face Bleach or Beautifier.

Syrupy lactic acid 40 oz.
Glycerin 80 oz.
Distilled water to 5 gallons (U. S.)

Mix; gradually add—

Tincture of benzoin 3 oz.

Color by adding—

Carmin No. 40 40 gr.
Glycerin 1 oz.
Ammonia solution $\frac{1}{2}$ oz.
Water to 3 oz.

Heat this to drive off the ammonia, and mix all. Shake, set aside; then filter, and add—

Solution of ionone 1 dr.

Add a few drachms of kaolin and filter until bright.

Toilet Talcum (Borated Apple Blossom).

Powdered talcum 22 lbs.
Magnesium carbonate 2 $\frac{1}{2}$ lbs.
Powdered boric acid 1 lb.

Mix.

Carnation pink blossom (Schimmel's) 2 oz.
Extract of trefle 2 dr.

To 12 drachms of this mixture add—

Neroli 1 dr.
Vanillin $\frac{1}{2}$ dr.
Alcohol to 3 oz.
Sufficient for 25 pounds.

Theater Rouge.

Base.

Cornstarch dr. iv.
Powdered white talcum dr. vj.
Mix.

No. 1.

Carminolin gr. x.
Base dr. vj.
Water dr. iv.

Dissolve the carminolin in the water, mix with the base and dry.

No. 2.

Geranium red gr. x.
Base dr. vj.
Water dr. iv.

Mix as above and dry.

No. 18 Rouge de Theater.

Carminolin rouge No. 1 oz. j
Geranium rouge No. 2 oz. iij.

Mix in a mortar to a paste with water, and mold or stamp out. Set aside to dry.

Violet Tooth Powder.

Precipitated chalk 16 lbs.
Powdered orris 4 lbs.
Powdered cuttlefish bone 2 lbs.
Ultramarine 9 $\frac{1}{2}$ oz.
Geranium lake 340 gr.
Jasmin 110 minims
Oil of neroli 110 minims
Oil of bitter almonds 35 minims
Vanillin 50 gr.
Artificial musk (Lautier's) 60 gr.
Saccharin 140 gr.

Rub up the perfumes with 2 oz. of alcohol, dissolve the saccharin in warm water, add all to the orris, and set aside to dry. Rub the colors up with water and some chalk, and when dry pass all through a mixer and sifter twice to bring out the color.

Cucumber Milk.

Simple cerate 2 lbs.
Powdered borax 11 $\frac{1}{2}$ oz.
Powdered Castile soap 10 oz.
Glycerin 26 oz.
Alcohol 24 oz.
Cucumber juice 32 oz.
Water to 5 gals. (U. S.)
Ionone dr. j.
Jasmin dr. ss.
Neroli dr. ss.
Rhodinol M xv.

To the melted cerate in a hot-water bath add the soap and stir well, keeping up the heat until perfectly mixed. Add 8 oz. of borax to 1 gal. of boiling water, and pour gradually into the hot melted soap and cerate; add the remainder of the borax and hot water, then the heated juice and glycerin, and lastly the alcohol. Shake well while cooling, set aside for forty-eight hours, and siphon off any water that may separate. Shake well, and repeat after standing again if necessary; then perfume.

Snow-white Cold Cream.

Select a white petrolatum of which you can lift a portion without its sticking to the spatula like stringy honey, and get the best bleached wax, then try the following proportions:

Petrolati albi oz. viij. vel oz. viij.
Cere alb. opt oz. viij. vel oz. ij.
Ol. petrolati alb. oz. xxiv. vel oz. xvj.
Aque rose oz. xvj. vel oz. viij.
Pulv. boracis dr. xss. vel dr. iiliss.

Melt the first three in a large water-jacketed pot or bath; dissolve the borax in boiling rose-water and pour gradually into the hot grease while stirring, then remove the bath from the fire and stir while cooling.

Perfume for above 56 oz.

Cumarin gr. iss.
Rhodinol dr. j.
Heliotropin dr. ss.
Ol. bergamot M x.
Ol. iris gr. ij.

Add the perfume and fill into pots while warm.

Special Massage Base (Skin Food).

Snow-white cold cream oz. iv.
Lanolin oz. iv.
Oil of theobroma oz. iv.
White petrolatum oil oz. iv.
Distilled water oz. iv.

In hot weather add—

Spermaceti dr. iss.
White wax dr. iiss.

In winter the two latter are left out and the proportion of cocoa butter is modified. Prepared and perfumed in proportion same as cold cream.

This is prescribed and recommended by Dr. Sands, the great New York skin and scalp specialist.

Violet Water.

Iridin dr. iij-se. j
Concrete orris gr. xl.
Schimmel's jasmin oz. j.
Oil of bitter almonds M ij.
White heliotropin gr. lxxx.
Deodorized alcohol O ix (U. S.)
Artificial musk dr. j.

Dissolve and add—

Powdered Florentine orris oz. iv.
Let stand for forty-eight hours, and add—
Distilled water oz. xvj.

Filter after seven days, and color green.

Extra Toilet Cologne.

Ol. bergamotti dr. vj.
Ol. limonis dr. vj.
Ol. neroli (Fries) dr. iij.
Ol. origan M xx.
Ol. rosmarini dr. iss.
Ol. aurant dule M xl.
Ol. caryophylli M xx.
Ol. santal flav. M v.
Ol. lavandula M x.
Ol. cassia cort M x.
Moschi artifact dr. ij.
S.V.R. ad O vj. (U. S.)
Aq. destillata oz. iv.

Let stand for a week, shaking occasionally.

Extra Florida Water.

Ol. lavand. opt oz. iss.
Ol. bergamot oz. iij.
Ol. cassia cort dr. ij.
Ol. caryophylli dr. j.
Ol. neroli (Fries) dr. iss.
Moschi artifact dr. j.
S.V.R. O v-oz. vj. (U. S.)

Mix in order.

Faba tonka contus. dr. iv.
Pulv. sem. angelice oz. ij.
Aq. bullentis oz. xxxij.

Infuse four hours or more and add to above; let stand one month. Every seven days siphon off the oils that float, rub them up with powdered pumice to form a thin cream, and mix in again. Shake once daily.

Cologne Spirits or Deodorized Alcohol.

This is used in U. S. A. in all toilet preparations and perfumes. It is made thus:

Alcohol, 95 per cent. Cong. j.
Powdered unslaked lime dr. iv.
Powdered alum dr. ij.
Spirit of nitrous ether dr. j.

Mix the lime and alum, and add them to the alcohol, shaking the mixture well together; then add the sweet spirit of niter and set aside for seven days, shaking occasionally; finally filter.

Prepared Cucumber Juice.

It is well to make a large quantity, as it keeps indefinitely. Wash unpeeled cucumbers are grated and pressed. The juice is heated, skimmed, and boiled for five minutes, then it is cooled and filtered. Now add

one part of alcohol to two parts of juice, let stand for twelve hours or more, and filter until clear.

Hair Shampoo

is a tincture of odorless soft soap which varies much as met with in New York. It is mostly perfumed with lavender and colored with green aniline. Prepared the same as tr. sapon. virid. (U.S.P.), using an inexpensive soft soap that is a good foam producer and put up in 4-oz. bottles at 50c., 8-oz. at \$1, and 16-oz. at \$1.50. Directions: Wet the hair well in warm water and rub in a few teaspoonfuls. The following formula No. A1 is considered the best:

	Parts Used.			
	No. A1	No. 2	No. 3	No. 4
Cottonseed oil	—	24	26	14
Linseed oil	20	—	—	—
Malaga olive oil.....	20	—	—	—
Caustic potash	9½	8	6	3
Alcohol	5	4½	5	2
Water	30	26	34	16½

Warm the mixed oils in a large water bath, then the potash and water in another vessel, heating both to 70 deg. C., and adding the latter hot solution to the hot oil while stirring briskly. Now add and thoroughly mix the alcohol. Stop stirring, keeping the heat at 70 deg. C. until the mass becomes clear and a small quantity dissolves in boiling water without globules of oil separating. If stirred after the alcohol has been mixed the soap will be opaque. Set aside for a few days in a warm place before using to make liquid shampoo.—Chemist and Druggist.

AUXILIARY POWER YACHT "MOLLIHAWK II."

Soon after steam began to be generally adopted for yachting purposes a great many efforts of a more or less ambitious character were made to combine the advantages of steam and sail propulsion on one bottom. Owners desired to possess a vessel which would be a sailing craft, and at the same time be able to steam when required at high speed. The compromises thus brought out were not generally successful. The vessels, as a rule, were low-powered steamers with large spars capable of giving a wide sail spread, which was seldom used, experience showing that once an engine and boiler were put on board a yacht very little sailing was done. Some enthusiastic owners, of whom Lord Brassey may be taken as a type, made a point of sailing as much as possible, but a man must have his skipper well under control to be able to carry out such a programme. As a rule auxiliary yachts possessed the disadvantages of both systems: a large amount of space was taken up by the machinery, while the spars and sails were simply an incumbrance.

The introduction of the petrol engine has, however, opened a new era for yachts in which the sail and power systems of propulsion are combined, and we now propose to describe two vessels that have been built on this plan. Our illustrations show the "Mollihawk II," a schooner-rigged vessel of 53 tons, with a full spread of canvas suitable for cruising purposes. She is fitted with an oil-engine of 30 to 40 brake horsepower. The illustrations show the general arrangement. This vessel was designed for Mr. G. A. McLean Buckley by Messrs. Linton Hope & Co., of Adelphi House, Strand, London, the motor being made by Mr. F. G. Blake, whose works are at Kew. "Mollihawk II," as will be gathered from the name, is the second vessel of this description owned by Mr. Buckley. "Mollihawk I." was an 18-ton auxiliary yacht, built in 1902, also from the designs of Messrs. Linton Hope & Co. This vessel was 45 feet 6 inches in length over all, and 35 feet on the load water-line, the beam being 11 feet. Her draft was 4½ feet; but this very moderate depth was compensated for by a centerboard, which brought the draft up to 8½ feet. The vessel was fully rigged, having a sail area of about 950 square feet. She was first fitted with a 16-horse-power two-cycle petrol motor, made in America. This engine, however, proved entirely unsatisfactory, being difficult to start, and could not be made to run efficiently. It was therefore removed, and a 12-horse-power, four-cycle, four-cylinder motor, made by Mr. F. C. Blake, was substituted. This engine ran exceedingly well, giving the vessel a speed of 6 miles an hour—a very good result considering the power, and that the boat was of 16 tons displacement. The original propeller and reversing-gear were retained, and it is estimated, from data obtained subsequently, that had these been efficient, a speed of 7 knots would have been reached. "Mollihawk I." was so satisfactory that the owner determined to build a larger vessel, with greater accommodation, the result being the schooner now illustrated. As stated, she has a 30 to 40 brake horse-power engine, which drives her at a speed of over 7 knots. It is hoped that this will be increased, as the owner is having a new propeller and reversing-gear fitted, the original reversing gear being unsatisfactory and leading to a loss of power through undue friction; it is estimated that fully 15 per cent of the power of the motor was lost from this cause alone. It may be taken, however, that 30 brake horse-power was the utmost actually employed in propelling the vessel, the motor running at 400 revolutions a minute. At this speed the consumption of petrol was about three-quarters of a pint per brake horse-power per hour. Although the cost for fuel might not be a very serious matter to the owner of a pleasure yacht, the figure shows how far we are—even if the world's supply of petrol were not limited—from driving ocean liners, and, still more, cargo boats, with petrol engines. This, however, is by the way, for we do not suppose any responsible per-

son would suggest such a course. "Mollihawk II." is 71 feet over all and 50 feet on the water-line, her beam being 15 feet. The draft is 7 feet 6 inches, and she was built under Lloyd's special survey of Class * 18 A 1. She is planked with teak, the frames being of oak, and the decks Kauri pine with teak fittings. She has a lead keel of about 18 tons, secured to the hull with heavy Muntz metal bolts, which go through the wrought-iron floors. Her total sail area with all set is 2,500 square feet. This is slightly less canvas than

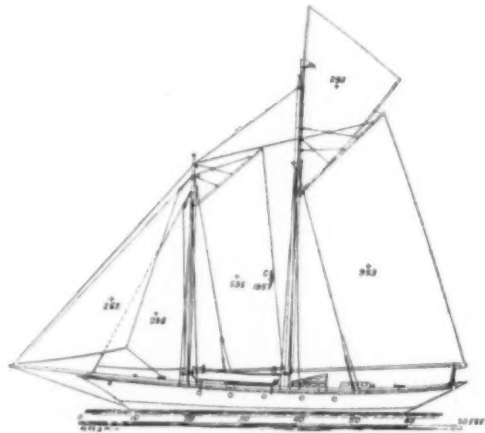


FIG. 1.—SAIL PLAN.

would be placed on a vessel of this size designed especially for fast sailing. As will be seen, however, the schooner is very snugly rigged, her main boom being plumb with the taffrail.

The vessel is especially interesting, inasmuch as she is one of the very few decked craft that have been fitted with a petrol engine. It is often held that this class of motor is quite unsafe to be put beneath decks, owing to the possibility of leakage and the escape of inflammable gases which might accumulate in the bottom of the vessel. In the present case, however, the engine room is an absolutely tight well, lined with sheet lead, and there is a ventilating fan designed to extract the air and petrol vapor from the lowest point in the engine room and discharge them overboard, fresh air entering through the ordinary ventilating cowl in the engine room hatch. The doors of the engine room are fitted with screw fastenings, and no odor of petrol is able to penetrate into the interior of the vessel. The petrol tank, it will be seen, is placed above the motor, just below the deck. It is, perhaps, a question whether it would not have been more advantageous to place it in the extreme bow. This, of course, would not be so handy for working, and there would be the disadvantage of pipe connections, which might leak. If, however, through any mishap an explosion were to occur in the engine room as at present arranged, the petrol in the tank would possibly ignite, and be blown all over the yacht's deck, perhaps causing a fire. On the

or it may be thought that the precautions taken render the risk of explosion so extremely remote that it is not worthy of much consideration.

As will be seen by Figs. 2 and 3, the accommodation in this vessel is ample, the saloon, owner's cabin, and ladies' cabin all being comparatively large rooms. The motor itself takes up so little space that the room in which it is placed is only 6 feet in length and 3 feet in breadth. The motor has four cylinders. These were cast in pairs together with the water-jackets and valve chambers, the jacket top being formed by a plate bolted in place. The valves are placed on opposite sides, and are automatically worked in both cases. As stated, the engine works on the Otto cycle. Mr. Buckley states that when running at full power there is practically no noise or vibration. Indeed, in the saloon

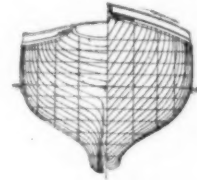


FIG. 5.—BODY PLAN.



FIG. 6.—HALF CROSS-SECTION.

adjoining the engine room it is difficult to tell whether the motor is running or not, a fact which shows the great advance made with this type of engine; the extraordinary clatter and vibration which the early ones set up being one of the chief objections to their use. Mr. Buckley speaks in the highest praise of the motor, and states he has never had the slightest trouble with it.

It is said that the presence of the propeller does not interfere with the sailing qualities of the yacht. In the big steam auxiliaries the propeller was always a difficult question. For the bigger vessels the Bevis feathering screw was generally used, so that the blades were turned fore and aft for sailing. This, however, was an expensive arrangement, and introduced a considerable amount of complication. With the necessarily quick-running petrol motor, the propeller must be of small blade area, and therefore the resistance is comparatively unimportant. At any rate, "Mollihawk II." is a fast vessel under canvas for her sail spread. The summer of last year was one of the worst yachting seasons on record, and no doubt many of our readers will remember the terrible gale in the Channel, which was possibly the most severe weather experienced during the summer season, at any rate for a very great many years. The "Mollihawk" was in Cherbourg shortly before the gale came on, and crossed the Channel in the strength of it. A gentleman who was on board has given us some particulars which may be of interest as showing what an auxiliary motor yacht of this size can do.

The yacht left Cherbourg at midday on Thursday, and the glass began to fall as soon as the harbor was cleared. When three hours out it had gone down three-tenths, and continued to fall at that rate. It was evident that it was to be a race between the yacht

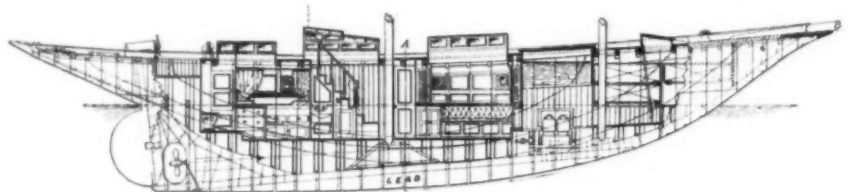


FIG. 2.—SECTIONAL PROFILE VIEW.

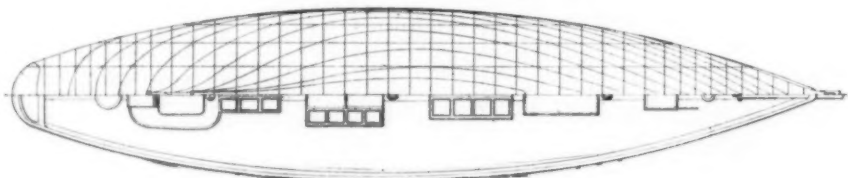


FIG. 3.—HALF DECK PLAN AND THE VESSEL'S LINES.

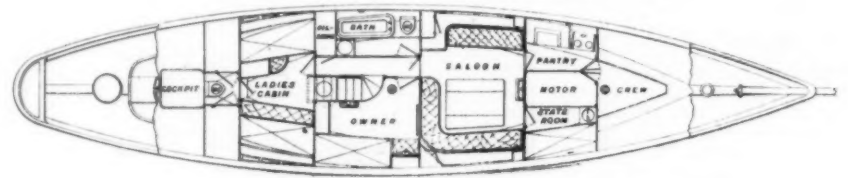


FIG. 4.—PLAN SHOWING THE ACCOMMODATION AND GENERAL ARRANGEMENT.

AUXILIARY POWER YACHT "MOLLIHAWK II."

other hand, if the petrol were away forward and an explosion were to occur, the well of the yacht forming the engine room might be, and doubtless is, sufficiently strong for the explosion to expend its force upward, carrying off the hatch if in position, but not damaging the hull of the boat. No doubt, however, these conditions have been fully discussed by the designer and owner, and possibly the question of accommodation had something to do with the present arrangement;

and the weather, and the owner decided to carry on, setting 2,000 feet of canvas, the wind being four points abaft the port beam. Until five miles off the Needles, the whole mainsail, large main topmast stay-sail, whole fore stay-sail, and spit-fire jib were carried, and these drove the vessel at a little over 10½ knots through a sea in which it would have been impossible to heave-to or reef. The Needles were not sighted until about 400 yards off, the ebb then running at its hard-

est, and the wind being of hurricane force, while the sea was boiling. On the Bridge Reef it was necessary to shorten sail, and this was done in seven or eight minutes without a change of course, the yacht being reduced to about 500 square feet in little more than ten minutes. This maneuver was only possible owing to the special reefing gear with which the vessel was fitted, the invention of Mr. Linton Hope. Having giped round the Needles, another 500 square feet of canvas were set. After being nearly run down by a big steamer not under control, the vessel was anchored off Ryde. One chain snapped, and she drove nearly a mile before she was brought up by her other anchor. A barge within a few hundred yards foundered about this time, while a yacht went ashore, with the loss of three lives. Doubtless many of our readers will remember the sad loss of life owing to vessels being wrecked, even in inclosed waters, on this memorable occasion, and will appreciate the seaworthy properties of "Molliehawk II," that came through such an ordeal without mishap.—Engineering.

THE KRAUSS SPEEDOMETER.

By our Belgian Correspondent.

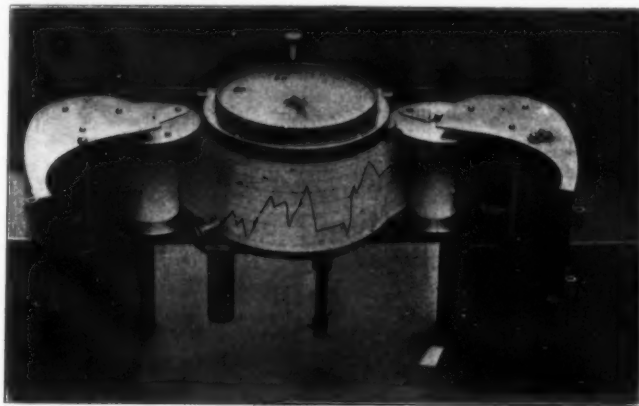
THE tachometer recently devised by M. Krauss, of Paris, is especially designed for automobiles. It is based upon a comparison between the speed of a wheel having a uniform motion and that of another wheel connected with the wheel of the automobile, and the speed of which is consequently variable.

Upon a plate which is turned at a regular speed by a clockwork movement, rests a roller movable upon a rod parallel with the plate. In the center of the latter, the roller is immovable, and the greater its distance

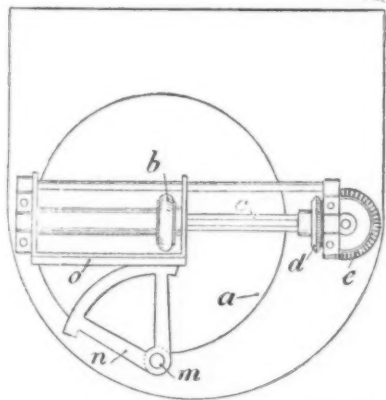
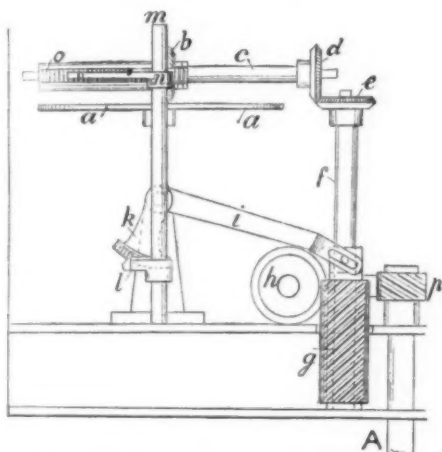
such a manner that the roller will always assume a position such that its tangential speed is equal to that of the circumference which it traverses on the disk. The following description will show how this problem is solved:

The upright shaft, *A*, is directly connected with the shaft whose speed it is desired to register. On its upper end is fastened a worm, *p*, which transmits the movement through a train of gears ending with the bevel gear, *h*, and the worm gear, *g*, which drives the shaft, *f*. The worm, *g*, is fastened to the shaft, *f*, with a sliding key, so that, although it drives this shaft, it

such that the number of revolutions of the worm, *g*, correspond exactly to those of the shaft, *A*. Any acceleration of the speed of rotation of the shaft, *A*, occasions an immediate ascension of the worm, *g*, which naturally makes the friction roller move more toward the periphery and increase its number of revolutions. A slowing down of the speed of rotation of the shaft, *A*, diminishes the number of revolutions made by the worm, *g*, and the friction roller, which is still moving too rapidly, feels the diminishment of the speed and forces the worm to become lowered to a corresponding height.



TACHOMETER WITH CASE OPEN.



DIAGRAMS OF THE SPEEDOMETER.

from the center becomes, the faster it will revolve, since, as it moves outward, it rubs over a constantly increasing circumference. Its speed is therefore a function of the radius of this circumference, and, from the measurement of the radius, it is easy to deduce the number of R. P. M. of the roller. The regular speed of the rotation of the plate and the diameter of the roller and its distance from the center constitute the elements of the calculation. Since the speed of rotation of the plate and the dimensions of the roller are known, it suffices to measure its distance from the center at every moment. This measurement of a straight line evidently offers no difficulty.

If we suppose the roller to be actuated by the machine in question, it will revolve at a variable speed. For each of its speeds, it will have to follow upon the plate a circumference such that the movement of the two parts shall be in harmony. It will move away from the center when the speed increases, and approach it when the latter diminishes. It will be easy to make it move a needle over a dial or inscribe its position at every instant on a sheet of paper. As for the apparatus itself, that comprises a finely ground metallic plate actuated by a clockwork movement and slightly pressed against a roller, movable in the interior of a rectangular frame.

The circumference of the roller is finely milled in order to assure its revolution over the plate without slipping.

The apparatus must, as just stated, be designed in

can be displaced longitudinally upon it. The object of this arrangement will be shown later on.

The shaft, *f*, through the bevel gears, *d*, *e*, drives the horizontal shaft, *c*, upon which is mounted the roller, *b*. The latter turns with the shaft, but it can also be displaced sidewise upon it, whereupon it carries with it a frame, *o*, which moves lengthwise of the shaft, *c*. This shaft is located over the exact diameter of the disk, *a*, which is rotated at a uniform speed by a clockwork movement, and upon the surface of which the roller presses lightly.

There are therefore two separate rotative movements to be compared—the uniform rotation of the plate, *a*, and the variable one of the shaft, *c*, which is connected by the various parts to the shaft, *A*, driven from the axle of the automobile when the instrument is used as a speedometer.

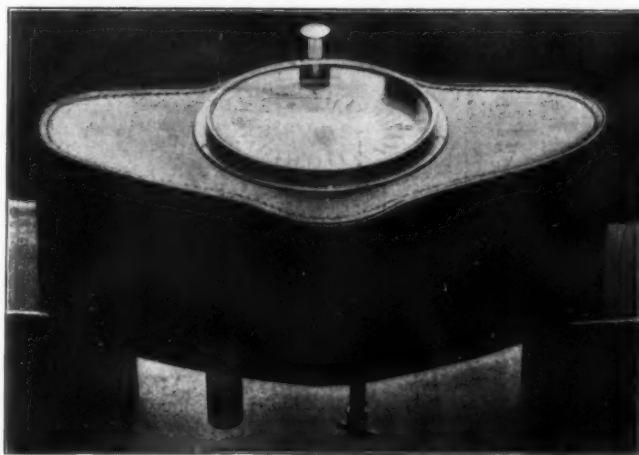
If the worm, *g*, driven by the bevel gear, *h*, rises on the shaft, *f*, it raises the lever, *i*, which is terminated by a toothed sector, *k*, that meshes with another sector keyed on the shaft, *m*, at one side of and below the plate, *a*. The shaft, *m*, upon turning, moves the horizontal sector, *n*, which meshes with a rack on the frame, *o*. The latter, moved toward the right, carries with it the roller, *b*, away from the center of the disk.

When *A* begins to rotate, the different transmissions of its movement cause the wheel, *h*, to act upon the worm, *g*, and the latter rises upon the shaft, *f*. This ascension causes, by means of the transmissions connected with the shaft, *m*, as indicated above, a displacement of the roller, *b*, which moves away from the center of the disk. As the latter is driven at a constant speed by a clockwork movement, it follows that the

Thus for all speeds of the shaft, *A*, there are determinate positions which the worm, *g*, and the roller, *b*, must assume. As every position of the roller on the disk determines a position of the shaft, *m*, it is easy to attach to the latter a segment which moves a needle and makes it possible to read on a suitably calibrated scale the number of revolutions of the shaft, *A*. In order to make permanent the indications of the needle, there is added to the system a simple registering apparatus. A band of paper can be drawn along by a clockwork movement, or can be driven from the shaft, *A*. In the latter case, it is the distance traversed that is indicated, while in the first case it is the time which is directly inscribed upon the band. Knowing the number of revolutions of the axle and the diameter of the wheel, the distance traversed is easily found.

THE GOLDFIELDS DISTRICT, NEVADA.

THE new camp of Goldfields, in Nevada, was revisited in November of this year by Mr. J. E. Spurr, of the United States Geological Survey. This district lies about 23½ miles south of Tonopah, and was located late in the spring of 1903. Shortly after the discovery of gold in this district it was visited by Mr. Spurr. A little work was then in progress on what is now known as Columbia Mountain, but up to that time no good strikes had been made. In January and February, 1904, however, rich finds were made in certain spots south of Columbia Mountain. The district has now an approximate population of 6,000. The town of Goldfields has sprung up, and a number of smaller adjacent camps have been established. It is estimated that up



THE KRAUSS TACHOMETER ARRANGED AS AN INDICATING AND REGISTERING SPEEDOMETER FOR AUTOMOBILES.

more the friction roller approaches the periphery of the disk, the more rapid is its rotation. But the friction roller, thanks to the transmission shafts, *c*, *f*, and to the bevel gears, *d*, *e*, acts in the contrary direction on the worm, *g*, that is to say, it forces *g*, by means of the bevel gear, *h*, to descend to its zero point, which coincides with the position of the friction roller at the center of the disk. Therefore, as soon as the shaft, *A*, begins to rotate at a certain speed, the worm, *g*, rises until the roller reaches on the disk the circle whose circumference gives it the number of turns necessary

to the present time about two million dollars' worth of ore has been shipped from the district. Most of these shipments have been made in the last five months.

The district is bounded on the west in part by a lava-capped mesa, the erosion of which has laid bare the underlying gold-bearing rock. The auriferous region is characterized by numerous low, irregular ridges standing out from the lower and more nearly level surface. These ridges owe their origin to hard reefs of quartz which form their crests. Their resistance to erosion has left them protruding thus above the gen-

eral elevation, and in these quartz reefs the auriferous deposits are found.

Columbia Mountain is the most prominent of these ridges, and some notes on its geology were made public by Mr. Spurr, last year, in Bulletin 225, published by the United States Geological Survey.

On his last visit Mr. Spurr took notes over an extended area, and made interesting additions to his knowledge of the geology of the district. The area of known ore bodies has spread since last year so far beyond Columbia Mountain that values are now found over an area about six miles square. The rocks were found to be almost entirely volcanic, consisting of rhyolites, rhyolite tuffs, andesites and basalts, all probably of Tertiary age. The alaskite and jasperoid of Columbia Mountain are hardly represented in the surrounding district, although at the Tonopah Club (mine) a patch of probable jasperoid (silicified shaly limestone), in this case constituting the ore, was seen. The predominant rocks are abundant rhyolites and andesites, while basalt is rare. The rhyolite resembles the rhyolite of the Gold Mountain district, which lies about four miles south of Tonopah, on the road between Tonopah and Goldfields; and this Gold Mountain rhyolite, again, resembles closely some of the phases of the earlier (dacitic) rhyolite at Tonopah. The relative age of the rocks at Goldfields has not been determined, but it probably corresponds to that of similar rocks at Tonopah.

At Goldfields the ores occur in both rhyolites and andesites, showing that mineralization occurred subsequent to the eruption of both lavas. At Gold Mountain the deposition of the ores evidently followed the eruption of the rhyolites, and at Tonopah the eruption of the earlier (dacitic) rhyolites was succeeded by a period of mineralization which produced irregular veins that frequently carry a larger proportion of gold than the locally more important veins formed after the eruption of the early andesite. There is therefore the possibility that the Goldfields deposits are identical in origin with the later series of veins at Tonopah. Indeed there are at Tonopah, in one place at least, mineralized quartz reefs in rhyolite tuffs that have the same peculiar characteristics as the tuffs of the Goldfields reefs; and assays of these Tonopah deposits have shown a moderate amount of gold and no silver.

At Goldfields there are no definite veins. The outcrops of the quartz bodies are irregular, straggling, branching, and apt to disappear suddenly. Neither were any definite systems observed, though further study might reveal them. There seems, however, to be a tendency to elongation in a northerly direction. The outcrops may even be nearly circular, or crescentic, and frequently they are roughly lenticular and intermittent. The quartz itself is gray and jaspery; it is almost entirely due to the silicification of the volcanic rock in which it occurs. Practically no ordinary crystalline vein quartz was observed.

All indications show that this silicification (and the accompanying mineralization) is the work of hot springs, and that these irregular reefs represent the horizontal sections of columns of rocks traversed by rising columns of hot water. Had the rocks been strongly fractured we should have had veins, like those of the early andesite at Tonopah, which were also probably due to hot-spring action; but at Goldfields the lack of such a fracture system resulted in this curious and rather unusual type of deposit. It follows that the quartz reefs will probably as a rule extend deeper vertically than horizontally, and so have roughly the nature of columns or pipes.

Although showing disseminated pyrite, the greater part of one of these jaspery quartz reefs contains little or no gold. Microscopic investigation has shown in one case that in such quartz the iron of the pyrite is probably mainly indigenous—that is, that the iron sulphide has been formed by the action of sulphur contained in the hot-spring waters, upon the iron silicates contained in the hornblende and biotite. This explains the absence of gold, as the pyrite has the same origin as the barren pyrite near the ore bodies in the country rock at Tonopah. Within some of these barren reefs of silicified volcanic rock at Goldfields, however, prospectors have sometimes discovered portions containing gold, even in large quantities. Such portions are usually lenticular or irregular, like the main quartz reefs, and they are not easily distinguishable from the barren quartz, except by panning or assaying; but it seems probable that these shoots are the real ore deposits, and that the mass of the reefs constitutes merely a siliceous jacket or casing, such as is shown to surround ore bodies in some other parts of the world. While this siliceous casing may be 25 or 30 feet wide, the auriferous portion may be only 1 or 2 feet; and the form and extent of this portion become evident only after the ore has been extracted. It is then seen to have a definite channel-like shape, often more regular than that of the whole outcropping reef, though it has usually a limited extent in the direction of its greatest elongation. It seems probable that these pay-shoots represent the main channels of hot-water circulation while the siliceous casings are the result of the water soaking through the adjacent rock.

The ores are often of very high grade. As an extreme example may be noted a shipment of 14½ tons from the Sundstorm (Kendall claim), which when worked in a stamp mill yielded \$45,783, while the tailings still contained about \$1,000 to the ton. From the McKane-Bowes lease on the Jumbo, \$600,000 was taken out in five months, from a space of 100 feet horizontally and 200 feet vertically on the shoot. One small shipment of 917 pounds of ore from this lease gave gross

returns of \$4,766. The whole production of the camp has been from ore which may be roughly estimated as averaging \$200 to \$300 per ton, or more. The values are all in gold; silver is usually practically absent, although the shipping ore from the Combination mine contains from 1 to 3 ounces.

It is important to consider the origin of this rich ore in order to make prophecies for the future. Most of that which up to the present time has been extracted, has been oxidized ore. The ores are mixed sulphides (usually pyrite) and oxides, clear up to the surface. The oxidized material, which follows cracks and seams, is usually several times (sometimes several hundred times) as rich as the unoxidized portion. The irregular spongy nature of the free gold particles in such oxidized material completes the proof that this gold has been dissolved and redeposited in a concentrated form during the process of oxidation. Iron sulphate derived from oxidation of the pyrites is the probable agent. A peculiar yellow coating pointed out to Mr. Spurr as the best sign of values in the oxidized ores was shown by Dr. Hillebrand to be a basic ferric-alkali sulphate containing both sodium and potassium—perhaps jarosite. Other sulphates such as alum and gypsum are abundant. As the water level at Goldfields is usually high for this desert country (water having been encountered in several shafts at from 150 to 200 feet) it is plain that this oxidized ore is only a temporary supply. In the Combination and the Florence mines, however, sulphide ores of very high grade have been found below the oxidized zone. In these mines a dark gray copper-bearing mineral, which is very rich, is most intimately connected with the gold. A specimen from the Combination, analyzed by Dr. Hillebrand, proves to be a sulpho-salt of copper, antimony, and arsenic, which so far as qualitative composition goes, may be tetrahedrite. Tellurium is also present in this ore, and the same element has been reported elsewhere in the district. Therefore the sulphide ores also may be very rich. Moreover, while the difference between the oxidized and the unoxidized portions of the ores within the zone of oxidation is in general so great, certain shoots occur, as in the January and the Jumbo, where the unoxidized quartz in this zone is of extremely high grade. Such ore appears to be mostly pyrite, but in view of the fact that tellurium is found in the district, it is very possible that gold telluride may be present. It therefore appears probable that the rich oxidized ores owe their richness not primarily to concentration during oxidation (though this process has certainly been very important), but to the existence of shoots of rich antecedent (sulphide) ore. Concerning the origin of these sulphides, it is probable that some, so far as can now be seen, are purely primary, while others have been formed subsequently to the main silicification of the reef, as in the Combination mine. Here the rich auriferous sulphides have formed in a broken zone (breccia-zone) in the silicified barren reef, and occur as seams, and often as coatings on the pebbles in the breccia. The question arises, however, as to whether the subsequent mineralization was the result of descending or ascending waters. Concerning this the evidence is not conclusive, but there is no sufficient evidence that these rich ores have been concentrated from the lean antecedent quartz mass. The presence of elements like arsenic, antimony, and tellurium in the subsequent sulphide ore suggests a deep-seated origin. Besides the elements mentioned above, bismuth occurs in the ore. In the January mine it occurs in the oxidized ores in the form of silvery scales, which is, as determined by Dr. Hillebrand, bismuth, perhaps the oxide bismite. In the Combination long needle-like crystals have been found, which, according to the manager, Mr. Collins, give the chemical tests for bismuth sulphide, bismuthinite. The silvery mineral above noted is sometimes found, in the January, arranged in long rod-like forms, and these are probably pseudomorphs after the sulphide. In the January this silvery mineral is usually, but not always, an indication of rich ore. Barite is a common mineral in all these deposits, but is not abundant.

The indications are, therefore, not unfavorable to the continuance of high-grade, or at least good-grade ores, down to considerable depths. There is, however, as has been already demonstrated by exploitation, no continuous regularity to the ore shoots, whether sulphide or oxidized. They are curving, irregular, and often lenticular, but it may happen that below a shoot which has come to an end, another shoot may be found occupying a slightly different relative position, or even overlapping the first. Similarly, the main quartz masses as a whole can be expected to show little regularity in depth; they may increase in size, or diminish—or even disappear, at least temporarily.

AEROLITES. RECENT RESEARCHES.

By M. BERTHELOT, Professor at College de France, etc.

AEROLITES or meteorites, designated in former times as stones which fell from the heavens, have attracted the attention of observers of these phenomena from the most remote antiquity, who attributed to them a divine origin. The luminous phenomena and the different noises which accompanied their fall have at all times struck the imagination and excited superstitious terror. The sudden manifestation of these phenomena, assimilated to those of comets, was regarded as a direful presage, announcing the death of sovereigns, or revolutions. For this reason the chroniclers noted them with great care. A certain number of these events are related in the annals of Oriental and European nations, in ancient times and in the Middle Ages.

The Roman writers sometimes make mention of showers of stones which seem to have had a like origin, although some modern authorities have attributed them to volcanic eruptions of Latium, perhaps without reason. An evident historical fact is the fall of a celebrated aerolite which is said to have the dimensions of a chariot, and took place at Ægos Potamos during the Peloponnesian war. Pliny observed a meteorite which fell in Gaul. The Greek philosophers, who were careful observers of natural phenomena, were deeply impressed by the circumstances in which the meteorites appeared. Diogenes of Apollonia regarded them as stars falling from the heavens, and their existence was not without influence upon the opinion of Anaxagoras as to the purely material character of the sun and moon, which he likened to solid masses about the size of the Peloponnesus. This seems to be the first step toward the idea of a similarity of constitution between terrestrial and celestial bodies, and in fact it was taxed with impiety, seeing that the aerolites were supposed to be of divine origin. Several of these bodies, from the most remote times, have become an object of worship and respect, as participating in the attributes of the Divinity. Such is the black stone of Mecca, which is the center of pilgrimage for the Mussulmans, and was already held in reverence before Mahomet's time. Another example is the stone which was worshiped in Galatia as representing the goddess Cybele. We may mention also the stone of Emesus, a personification of the sun, of which Heliogabalus was the high-priest before he became the Roman Emperor.

We know that a certain number of these aerolites are formed of different compounds of iron, in a nearly pure state. Some archaeologists consider that the meteorites were the starting point in the use and production of iron by the human race. The knives which some Esquimaux tribes use, even in modern times, probably have this origin. Meteoric iron has been employed for forging the swords which were reputed as talismans among the ancient peoples, such as the sword worn by Mahmoud the Ghaznevide in the eleventh century of our era. An iron glaive, adored by the Scythians as a symbol of the war deity, was also reputed of celestial origin.

Regarding the more positive ideas upon the nature of aerolites, we may say that their celestial origin and even the reality of their fall were doubted, in the period following the Middle Ages. In fact, certain authors thought that they were formed in the atmosphere by the condensation of metallic vapors which emanated from the interior of the earth, in conformity with Aristotle's hypothesis which attributed the production of metallic minerals to natural emanations. In this way the appearance of meteorites was likened to that of aqueous phenomena, such as hail and snow, which are condensed from the water vapor of the air. Some savants of the eighteenth century, which was an epoch of skepticism brought to an extreme by reaction from the old prejudices, even denied the fact that such bodies fell to the earth at all. But this idea could not subsist in the presence of the methodic observations made by Chladni in 1794; he brought together the historical proofs and authentic testimony as regards these facts. It was not long before all doubt was dissipated, following the examination made by the Paris Academy of Sciences at the time when the celebrated meteorite of Laigle fell in France on the 26th of April, 1803. It exploded in the air during the daytime. The light and the noise of the explosion were perceived by several thousand persons and from two to three thousand fragments were collected. Since that time many celebrated events of this kind have occurred and their products have been collected in different countries. These meteorites have been well analyzed in order to find their physical and chemical constitution and the nature of their components, regarded as fragments of cosmic substances existing outside of the earth. In fact, no element has been found in them as yet which does not exist on the globe, in spite of their extra-terrestrial origin. This hypothesis, when once demonstrated, will tend to establish a remarkable identity of chemical constitution between the terrestrial substances and those of the sidereal world. We may consider the facts which have been observed upon several hundred meteorites since that epoch, as regards their origin, the conditions of their fall, their initial characteristics and the modifications which they undergo during their descent. Specimens coming from 283 meteorites were already assembled by Daubree in the collections of the Paris Museum of Natural History, and this number has increased considerably. We propose to observe the constitution of the aerolites as compared with rocks and terrestrial minerals, resulting from the comparative researches made upon the latter, especially as regards the native iron, and we will then sum up the synthetic tests and the attempts made to reproduce and explain the phenomena which accompanied the cosmic formation of the meteorites or their penetration into our atmosphere. Generally aerolites are identified with bolides and shooting stars. Thus the name *bolide* is especially given to bodies which penetrate into the air with incandescence before coming in contact with the ground. Shooting stars, which have been observed in all ages, are aerolites which traverse the atmosphere without touching the earth and pass out again, because their height and speed are too considerable. As to the shooting stars, their assimilation with the meteorites has raised different problems as to the existence of bodies which are foreign to the earth and to the stars proper, in the celestial spaces. Whence comes that multitude of small solid masses, which are distinct from the great sidereal masses form-

ing the planets and what is their manner of circulation in space?

Three main hypotheses are proposed—terrestrial origin, lunar or cosmic origin, without counting the ideas proposed by the ancients. Some suppose that the meteorites come from the projection from volcanoes on the earth. At first they are shot with an enormous speed at the time of the eruption and the masses are thus under conditions which are different from ordinary falling bodies. They describe orbits around the earth which are more or less elongated. Sometimes they leave the regions where the earth's attraction predominates, so as to move in the celestial space, or again they come to the surface of the earth after a certain time. But this hypothesis is not generally accepted, on account of the difference of composition which exists between volcanic lava and meteorites. Besides, it is not confirmed, on account of the absence of the concord it demands between appearance of aerolites and volcanic eruptions. It would also give speeds to the matter coming from volcanoes which exceed the ordinary by too great a degree. Nevertheless it is admitted at present that certain great masses of native iron which have been heretofore regarded as meteorites, may have come from the interior of the earth at prehistoric epochs. It is also admitted that the dust which is sent up in some modern eruptions, such as that of Krakatoa, remained in suspension and circulated in the atmosphere like mists or fogs, sustained by air-currents on account of their extreme lightness, during a considerable time. This dust when illuminated by the rays of the setting sun gave rise to those unusual colorations of the atmosphere which were visible over a great part of the globe and sometimes for several days. But the great majority of meteorites are not likened to dust. They have a certain speed of motion which is independent of air currents. By their volume and their mode of circulation they cannot be brought into the category of these exceptional dust particles. However, what the earth's volcanoes seem incapable of doing seems not impossible *a priori* for the lunar volcanoes, whose existence is admitted by many astronomers. In fact, the attraction of the moon acts with much less force upon bodies than the earth's attraction, on account of the difference between the two masses. Laplace admitted this second hypothesis as a possible explanation of aerolites. Arago showed, in fact, that it would suffice to admit, for projectiles sent from the moon, a speed of 8,000 feet per second, this being triple that of our modern cannons, in order that these projectiles should leave the sphere of the moon's attraction and enter the earth's sphere. It thus becomes easy to explain the identity of chemical elements in the aerolites with those of the earth, since according to Laplace's theory of the formation of the planets and the moon, the latter separated from the earth by a condensation of part of the earth's atmosphere at a certain epoch.

But the discoveries of modern astronomy relating to the spectrum analysis of the light from the stars show that the identity of chemical elements does not exist exclusively between the aerolites and the moon, since the earth's elements are also found in the sun and the fixed stars. We should also take account of the results found on observing shooting stars which are generally likened to aerolites, as these results are specially favorable to the third hypothesis of cosmic origin. Both are projectiles which penetrate into the earth's atmosphere endowed with a great speed, as is attested by the existence of trajectories which are quite unlike those which gravity would produce. Their direction is a resultant of the combination of the initial speed with the effects of air resistance and gravity.

According to astronomers' measurements, this penetration into the air which surrounds us becomes visible on account of the light which accompanies it, at a height of 40 miles or more. This also gives a proof of the extension of the atmosphere to that height at least. This light results from the incandescence of the projectile, produced by the loss of its *vis viva* from the air resistance and to some extent by the ignition of combustible material in it. In fact, at the moment of contact with the aerolite, the air is compressed, and a certain part is even drawn along by the projectile as in the case of a bullet or even a railroad train, whence result the effects which are like the shock of a projectile against a solid body. It sometimes breaks in fragments like an explosive body and the fragments fall to the ground. At the same time a part of the *vis viva* of the aerolite which disappears is transformed into heat and this is sometimes sufficient to raise the projectile and even part of the surrounding air to incandescence. This effect, according to the case, may be total, partial, or only on the surface. The phenomena vary according to the initial speed of the body and the length of its path. The latter is longer as the speed is greater. The temperature of the aerolite will be raised still higher where the materials enter into combustion. For this reason they sometimes have an apparent diameter as large as the moon.

The appearance of the aerolites is accompanied by a noise which we may liken to that of a shell which is shot for several miles through the air, although the speed and loss of *vis viva* here is not enough to make them glow. These luminous and sound effects are common to aerolites and shooting stars, although they were separated at first because the former reached the earth's surface while the latter only passed through the atmosphere. However, the study of the latter bodies shows us some highly interesting characteristics.

Often they present the phenomenon of a shower of fire which reveals the great number of bodies which penetrate the air at the same time. Besides, and this is a capital point, these showers seem to come from certain well-defined radiating sources like periodic swarms of asteroids. Schiaparelli was led by these facts to connect the swarms with the disappearance of certain vanished comets of which they are the last vestiges. In the course of their regular cycle these are reduced to fragments dispersed in the neighborhood of the great planets, such as Jupiter. But these fragments keep the periodicity of their path, according to mechanical laws. Thus the origin of shooting stars is brought in line with the prevailing opinions as to the formation of our planetary system. According to this hypothesis, when the projectiles having cometary speeds such as 60,000 to 150,000 feet per second approach the earth and reach the sphere where its attraction predominates, they continue their movement according to a path which is often slightly inclined to the horizon, the resultant of their former direction, the resistance of the air and the earth's attraction. Some of them traverse the atmosphere and pass beyond. These are the shooting stars. Others are precipitated to the earth's surface, and constitute the aerolites, to which their passage through the air gives some new characteristics.

If the cohesion of the aerolite is not sufficient, its shock against the air, as we said, brings about an explosion and scattering of debris. Sometimes there are several thousand pieces. The weight of these fragments varies from a few ounces up to several tons. At this time there is produced an immense cloud of impalpable dust which long remains suspended in the air and whose composition gives proof of its origin. We stated above that it is difficult to distinguish them absolutely from the dust produced by the great volcanic eruptions. In all the cases where the body falls to the ground, it penetrates into it more or less deeply. Besides, whether it arrives whole or in large pieces, two heat phenomena are shown which are somewhat contrary. The surface of the fragments is hot and usually covered with a kind of enamel, resulting from a surface fusion. But the center may have kept a very low temperature, which is a witness of what reigns in the interplanetary space.

We have just exposed the prevailing ideas about aerolites and shooting stars, but nevertheless we must add that some reserves have been made in the preceding theory, which tends to assimilate completely the origin of aerolites and shooting stars. In fact, no considerable fall of meteorites has coincided up to the present with the regular and periodic passage of shooting star swarms. For this reason several have thought that we should perhaps distinguish the two kinds of phenomena, or even come back to the opinion that aerolites are shot from lunar volcanoes. These reserves are perhaps excessive, for the celestial space could easily contain at once the periodic swarms of asteroids of cometary origin and disseminated sporadic fragments which do not obey any general law of circulation and form the aerolites.

The number of these bodies which are now known is so great that in order to define them it has been necessary to class them in a certain number of general groups. Their classification has been developed mainly by Daubrée since 1863. It is founded on their chemical composition. One fundamental consideration prevails; it is the existence or absence of iron. Whence a first grouping *siderolites* or *siderites*, nearly always containing some nickel, and *asiderites* which contain no iron. To enter more into the details, on account of the great number of the specimens Daubrée distinguishes the *holosiderites* which are entirely metallic; the *polysiderites* and the *aliosiderites* according to the proportion of iron; the *sporadosiderites*, where the iron is disseminated among other matter; the *cryptosiderites* where it is found in such small particles that only the microscope can perceive them or the magnet separate them from the powdered material.

Among the meteorites having no iron, we distinguish those which are formed of rocky matter, mostly silicates. The latter are often found with iron in the complex specimens. Some exceptional bodies like the Orgueil meteorite contain substances which do not resist a red heat and even a lower point, such as a double carbonate of magnesia and iron, and certain hydrocarbon compounds. These latter, as I have found by experiment, can produce hydrocarbons under the influence of some reducing reactions such as those of hydriodic acid at a temperature of 250 or 300 deg. C. The origin of these bodies is thus quite different from the others and is not to be interpreted in the same way.

Examination of these different classes of meteorites and especially that of the ferruginous and rocky varieties reveals circumstances of the greatest interest on account of the original connection between these bodies and the different rocks of the earth's crust, also as to their physical and mechanical properties and especially as to their chemical composition. We first note that the heat developed at the surface of the body during its path in the air has determined various effects such as the formation of a black and slag-like surface layer coming from fusion, formed either directly or by the effect of an oxidation at the time of passing through the air. The aspect of the surface, especially in the case of metallic meteorites, shows some appearances and modifications which can be attributed to the same causes—for instance, the wrinkles developed on the softened surface, whose direction shows the projectile's movement, also hollow places and streaks and

effects like those of iron under the burnishing tool. All these effects are to be attributed to the compression of the air in front of the meteorite, and the air then acts as a solid body whose action combines with the whirling movement of the mass, the latter resulting from the lack of symmetry of the different parts around a fixed point.

To carry out his observations here, Daubrée made a long series of curious experiments by means of the highest explosives, powder or dynamite, exploding them either in closed vessels where the density of the gases comes near that of solids, or again in the open air. In fact he could realize conditions of the same order, especially with substances whose explosive duration did not last more than a few hundred-thousandths of a second. He thus reproduces the same appearance of whirling movement, streaks and cutting, which the meteorites show. These appearances are to be attributed partly to the action of a portion of the matter reduced to solid dust, but also in part to the action of the gases themselves which are at the same time compressed and possessed of extraordinary speeds.

We may now examine more closely the structure and chemical composition of meteorites. Their comparison with terrestrial rocks brings out some points of great interest. The composition of the meteorites is of the most characteristic. Most of them show a kind of air, which is revealed by the presence of iron associated with nickel. We know that the existence and the special structure of the crystalline alloys mixed with the iron are shown by divers signs, specially by the structural figures known as Widmannstetten figures. They are brought out by polishing the surface and treating it with an acid. But we note also the minerals which accompany the metallic iron in the aerolites. We find, in fact, silicates associated with certain compounds where metals are combined with sulphur or phosphorus (magnetic pyrites, pyrrhotine, schreibersite, etc.). But we do not find any compound pertaining to stratified rocks, nor any fossils of animal or vegetable origin, except perhaps some traces of hydrocarbon compounds in the carbonated meteorites such as the Orgueil specimen. We do not find any minerals whose formation implies the original reactions of water. The iron is not in the state of peroxide. But we repeat that up to the present no element foreign to the earth's simple bodies has been found, nor any different compounds.

The silicates contained in the meteorites show the general character of belonging to the group of basic silicates, that is, the ones which are observed in the deepest rocks and among the eruptive rocks, the silicates which have not been deprived of a part of their alkalis under the influence of water and carbonic acid, contrary to what happens at the surface of the earth. Among these may be mentioned specially the compounds contained in the lherzolite of the Pyrenees, the peridot, and also the pyroxene enstatite, bronzite and more rarely the anorthite.

Daubrée, who found out these relations, after having seen the close relationship between the two orders of substances, sought to penetrate farther into the problems of origin, and thus made a number of experiments. The most interesting part of his work consists in comparative experiments on the fusion of meteorites and of certain natural rocks, such as the lherzolite of the Pyrenees. This fusion, in fact, can be tried with the meteorite on one hand and the rock on the other, either separately in a crucible, or with the addition of oxidizing substances, air or peroxide of iron, or again with reducing substances, carbon or hydrogen. Simple fusion is likely to modify considerably the composition and distribution of the elements, in bringing about the reduction of a part of the compound, for instance by producing iron at the expense of another portion of the matter. This change already gave certain indices as to the temperature limits between which the meteorite could have been originally formed or those which it might have traversed. Thus Daubrée observed that certain melted meteorites became changed to a slag containing a large amount of crystallized peridot and enstatite or other minerals mixed with grains of iron. The peridot thus formed is a constant product of the operations. This is very remarkable, for the peridot constitutes the most basic type of silicate, existing in meteorites and in eruptive rocks, while it is wanting in sedimentary stratified regions. If it is easily manifested in the preceding conditions it is on account of its aptitude to crystallize by simple fusion. Besides, its density is greater than that of eruptive rocks, which circumstance is correlative of its presence in the greatest accessible depths of the globe. We may add to complete the enumeration of the properties of peridot, that it readily gives up a part of its bases (magnesia, iron oxide) under the action of silica in excess, thus changing into more acid and less fusible silicates. It seems thus that peridot is capable of representing the first product of oxidation of iron and other metals contained in the earth or the planetary bodies.

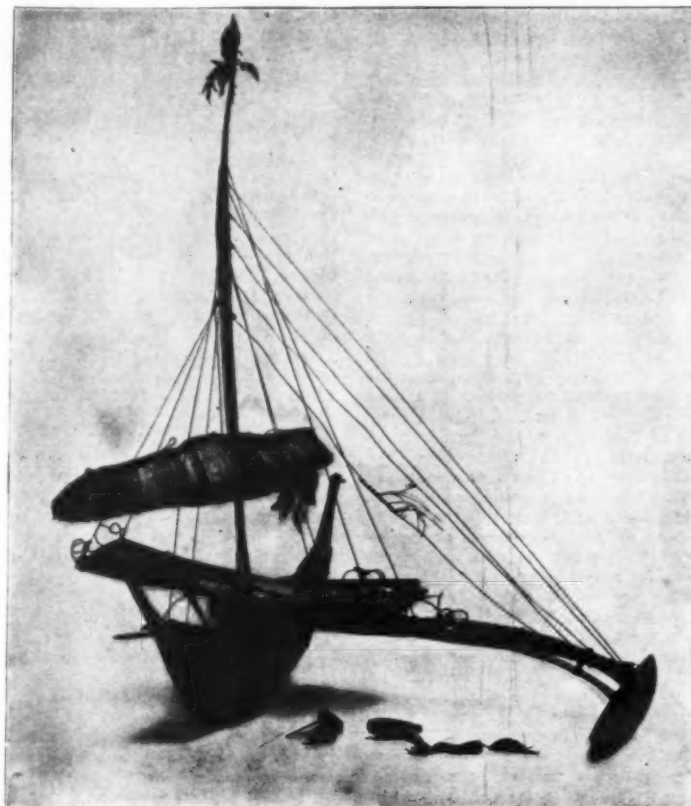
From these deductions there was only a step to be taken toward an experimental verification. Daubrée at once proceeded to submit the lherzolite, a rock containing a large quantity of peridot, to the same tests as the meteorites, and specially to the action of hydrogen and carbon. The experiment succeeded and he obtained similar products in the two cases and specially the regeneration of metallic iron in the form of grains, even containing nickel, another element of the meteorites. This capital experiment, upheld by a whole series of analogous tests, led him to regard

the different meteorites as representing different degrees of oxidation of an initial mass composed mainly of iron. Thus peridot becomes a fundamental substance in the history of the globe. It is the *universal scoria*, and the history of the earth is brought by this hypothesis to conditions which are common to the rest of the universe. The study of meteorites thus becomes one of the foundations of geology.

Comparison of meteorites and the earth's rocks may be even brought further, up to the study of meteoric iron itself. In fact, a close examination of rocks and natural products found at the surface of the earth gives rise to other resemblances of the highest interest. Large masses of metallic iron have been observed in different countries. They were attributed at first without any direct proof, to the fall of meteorites at an unknown period. But a closer observation has since led to give them a purely terrestrial origin. The question was brought up by the discovery in 1870 of enormous masses of iron by Nordsenskold at Ovisak (Greenland). He found on the shore fifteen great metallic blocks distributed over a space of 70 square yards, and of which the largest weighed about 20 tons. Since then, a part of this mass was brought to Stockholm and put through a series of careful analyses and tests. Some specimens I have examined myself. These fragments show a composition and structure analogous to meteoric iron. But we could hardly assign them an extra-terrestrial origin, for these masses are associated with eruptive rock of the basalt order. It was not long before certain other immense pieces of iron supposed formerly to be meteorites, were likened to the former, such as those of Santa Catarina, Brazil, weighing 25 tons, the Durango specimens, weighing 20 tons, the Cañon Diablo mass from Mexico in which traces of diamonds were perceived, also a natural alloy of iron and nickel found in New Zealand, and others. A fact that bears out these resemblances is that several of these masses, like the Ovisak specimens, are accompanied by basaltic rocks. But the examination of the latter with the magnet or the microscope shows the existence of globules of melted iron. We are thus led to consider these basalts and the ferruginous masses which accompany them as samples of the interior layers of the globe. The resemblance

blance is all the more likely in that the mean density of the globe is much superior to that of the surface rocks, and near that of metallic iron. On the other hand, we have since found masses of native iron sepa-

tuting the earth's core for the origin of the carbon which exists at the surface, that is to say, the capital element which has contributed to the formation of carbonic acid and the constitution of living organisms.



MODEL OF MARSHALL ISLANDS CANOE, SHOWING STRUCTURE
AND MAT COVER SAIL.

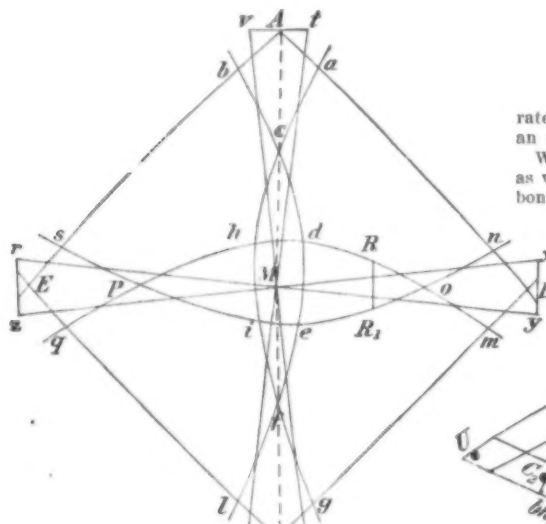


CHART I.—A MATTANG OR INSTRUCTION CHART.

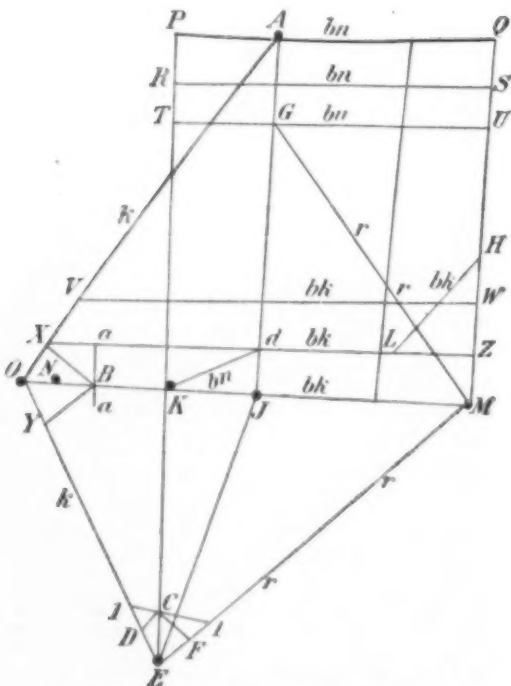


CHART II.—MEDDO, COVERING PART
OF A GROUP.

rated from basalts and lying upon granite. Therefore an absolute conclusion cannot be drawn at present.

We observe again that these samples of native iron, as well as those of the meteoric iron, both contain carbon. This fact leads us to look in the masses consti-

I may be allowed to say that I likened to a similar hypothesis the formation of petroils, natural hydrocarbons, by comparing them with acetylides and other metallic carbides which I obtained by synthesis. The petroils thus might result from the action of water on natural metallic carbides contained in the depths of the earth. This hypothesis has since been taken up by M. Mendeljeff and it has also obtained a fresh confirmation by M. Moissan's thorough study of metallic carbides.

We have thus exposed the facts observed in the study of aerolites and the hypotheses to which their origin has given rise, also the ensemble of the synthetic researches which they occasioned and whose object is to compare them with rocks and terrestrial matter and thus to give further information on the formation of these latter as well as the constitution of the celestial bodies. In this way our knowledge in geological and astro-physical lines has been greatly extended.—From *Revue Scientifique*.

[Concluded from SUPPLEMENT No. 1519, page 24341.]

ON SEA CHARTS FORMERLY USED IN THE
MARSHALL ISLANDS. WITH NOTES ON
THE NAVIGATION OF THESE IS-
LANDS IN GENERAL.*

By CAPT. WINKLER, of the German Navy.

Among the charts with which I am acquainted, there are three kinds: Those that represent the entire group of islands, Ralik and Ratak chain together; those which represent only single parts of groups; and those which serve only for general instruction without referring to particular islands. The charts of an entire group or chain are called Rebbelib; those of smaller sections, Meddo; the instruction charts are termed Mattang.

I have in all five separate charts, now in the Museum für Völkerkunde in Berlin. They are a Mattang; a Rebbell for the whole island group; a Meddo for the southwestern part of the group; a Rebbell for the Ralik chain; and a Rebbell for the Ratak chain. Now these charts are not generally serviceable, for the makers of them, while of course following the general plan, designed the charts for their individual use, not only as charts but as reminders of various things known only to them. This fact causes some apparent contradictions and inaccuracies, a difficulty often found in deciphering the records of savage peoples, and which may be traced to the same cause.

CHART 1.

Dimensions from *A* to *B*, 31.6 inches. It is a Mat-tang, or instruction chart, which only explains in a general way the course of the swells between two islands. The islands are at *A* and *B* for the north-south course, and at *D* and *E* for the east-west course. While *AD*, *DB*, *BE*, and *EA* serve rather as a framework to hold the whole together, still *DA* and *DB* were pointed out as the rilib or east channel for *D*; *EA* and *EB* the

* Translated for the Smithsonian Annual Report from *Marine-Rundschau*, Berlin, 1906, pt. 10, pp. 1418-1430, with plates from the United States National Museum and other collections.

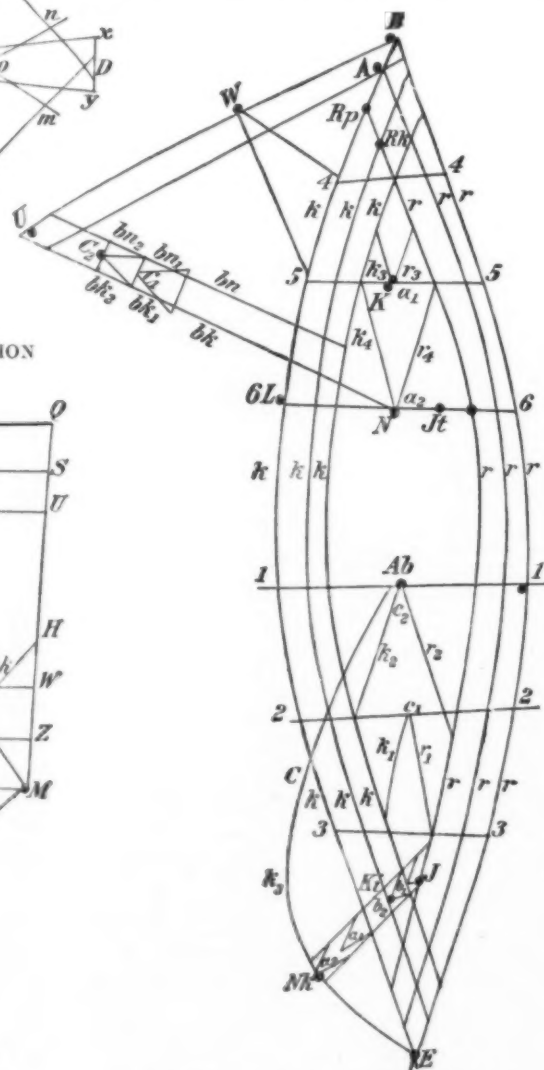


CHART III.—REBBELIB OF RATAK CHAIN.

kaelib, or west channel for *E*; *AD* and *AE* the bungdokerick, or north channel for *A*; *BD* and *BE* the bungdokerick or south channel for *B*.

R R points out the rear or east.

t M is an east swell or rilib for *A*.

r M is a kaelib or swell for *A*.

u M is a rilib or east swell for *B*.

u M is a kaelib for *B*.

By means of these straight rilibs or kaelibs, intersecting at *M*, is to be shown how a navigator may

CHART II.

Dimensions of the chart, from *o* to *M*, 27.6 inches; from *P* to *E*, 38.8 inches. It is a Meddo, or part of a group, and shows the positions of the islands in the southwestern portion. It contains likewise a series of lines for instruction.

The shell at *J* represents the island Jaluit; that at *E*, Ebon; at *N*, Namorik; at *K*, Killi; at *M*, Mille; and at *A*, Ailinglablab.

The lines *MG* and *ME* (*rrr*) determine the rilib, or



REBBELIB, ROYAL ETHNOGRAPHIC MUSEUM, BERLIN (VON LUSCHAU).

cross from *A* to *B* in a straight line, by always keeping between rilibs and kaelibs.

ac is another rilib, *bc* another kaelib for *A*. *gf* is another rilib, *ef* another kaelib for *B*. These lines are intended to show how the rilib and kaelib of *A* come together in boot or "knot" *c*, the rilib and kaelib of *B* in the boot or "knot" *f*. If there were no current, there would be a series of other boots from *c* to *M* and *f* to *M* which would form a direct okar or line of guides between *A* and *B*. On the curves *cdef* and *chif* will be demonstrated that the course of the okar is, as a rule, not straight, but is set to one side, *cdef*, or the other, *chif*, through the influence of the eastern or western current.

Entirely analogous is the use of the lines between *D* and *E*.

ym is a bungdokerick or southern swell for *D*.

zm is a bungdokerick or northern swell for *D*.

zm is a bungdokerick for *E*.

rm is a bungdokerick for *E*.

mo is a second bungdokerick for *D*.

no is a second bungdokerick for *D*.

qp is a second bungdokerick for *E*.

sp is a second bungdokerick for *E*.

The course of the okar between *D* and *E* is shown on its southern offset by the line *pico*, on its northern one by the line *phdo*.

east channel, for the island of Mille; the lines *OA* and *OE* (*kk*), the kaelib or west channel for the island of Namorik; the lines *PQ*, *RS*, *TU* (*bn*) give the bungdokericks, or north swells, while the lines *OM*, *XZ*, *VW* (*bk*) give the bungdokerick or south swell in general. *HL* is intended to represent a bungdokerick for Mille Island, yet it is placed on the left above instead of on the right underneath, since there is no place on the chart to tie it correctly.

Kd is intended to show a bungdokerick or north swell for Jaluit Island, and at the same time a jur-in-okme or "post" for Killi Island. *KB* is designed to show a rolok, "lost course," *YB*, a nit-in-kot or *cul-de-sac* for the point *B*. The line *aa* passing through *B* stands for the no-in-rear or "sea from the east." The line *ii* passing through *C* is an *ai*, land or distance mark for Ebon Island. *CF* is a rilib or east swell, *CD* a west swell for Ebon Island. *C* is the boot formed by the two on the okar *KE* between Killi Island and Ebon Island.

CHART III.

Dimensions from *B* to *E*, 62.4 inches; from *B* to *U*, 26.4 inches. It is a rebbelib or group chart of the Ralik chain. The positions of the islands are insufficiently indicated by the mussels, as a comparison with regular charts shows. The interpreter did not understand it at all. Its chief purpose appears to be the in-

dication of the different shallows and their direction.

Beginning at the south, the identification of the shells is as follows: *E* = Ebon Island; *Nk* = Namorik; *Ki* = Killi; *J* = Jaluit; *Ab* = Ailinglablab; *Jt* = Jabwat; *N* = Namu; *L* = Lib; *K* = Kwadjelinn; *Rk* = Rongerik; *Rp* = Rongelap; *A* = Ailinginae; *B* = Bikini; *W* = Wotho; *U* = Ujae.

The three curves, *r*, *r*, *r*, extending on the right side from *B* to *E*, represent three rilibs; the three on the left side, three kaelibs. The boots or "knots" on the okar extending from the island of Jaluit to Namorik are indicated at *A*, *A*, which are occasioned by the bungdokerick, or south swell, and the bungdokerick, or north swell. They should properly lie in points *b*, and *b*, running out from Jaluit Island, but the explainer said that he knew what was intended, even if they did not follow the general plan.

The boots on the okar leading from Jaluit Island to Ailinglablab Island are shown at *c*, and *c*, which are formed by the rilibs *r*, and *r*, and the kaelibs *K*, and *K*. Here also is *c*, again too close to Ailinglablab. The boots on the okar from Rongerik to Kwadjelinn and then to Namu are shown by *d*, and *d*, formed by the rilibs *r*, and *r*, and the kaelibs *K*, and *K*. The boots on the okar from Kwadjelinn to Ujae, *e*, and *e*, are formed by the bungdokericks *bn*, *bn*, and the bungdokericks *bk*, *bk*. The guide on the chart passes from Namu to Ujae Islands, but the explainer asserted again and again that it was the okar from Kwadjelinn to Ujae, and that the mussel at *N* could just as well represent Kwadjelinn as Namu, notwithstanding his previous designation of *K* as Kwadjelinn.

The line *bn* explains the northern bungdokerick, *bk* the southern bungdokerick, whose ends *bn*, *bn*, *bk*, and *bk*, form the boots *e*, and *e*.

The curve *k*, passing from *Ab* through *C*, *Nk*, and *E*, represents a kaelib or west swell.

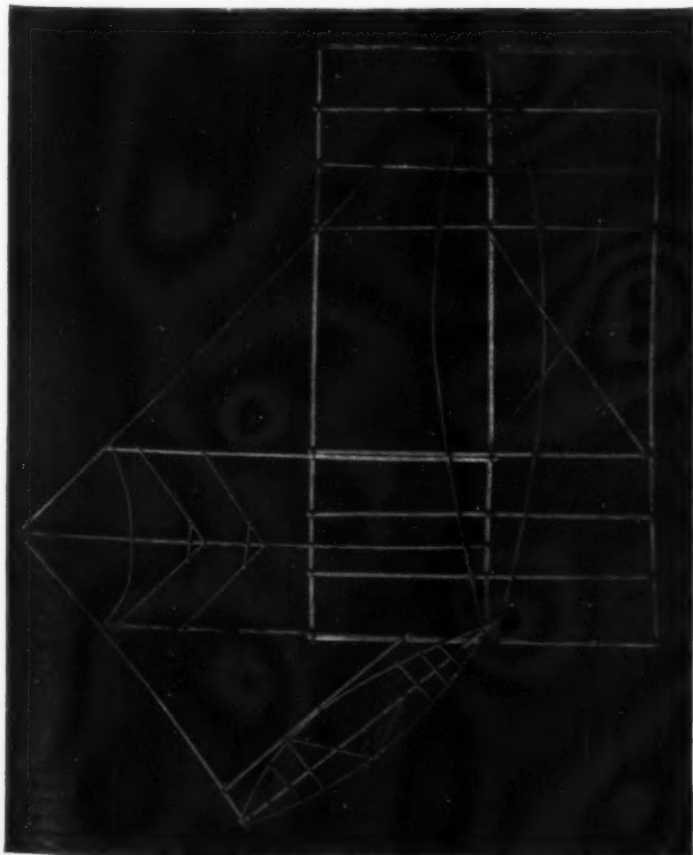
To one coming from the north the line 1-1 stands for the djugal of Jaluit—that is, the distance at which the island passes out of sight; 2-2 for egedai, or distance at which the island may be seen from the canoe; 3-3, for the djelladaï, or the distance at which the palm trees may be distinguished. The line 4-4, to one coming from the north, represents the djugal of Namu Island; 5-5, the egedai, and 6-6, the djelladaï. In like manner on these lines, the bungdokericks and the bungdokericks are made plain.

This rebbelib, or chart of the whole group, is especially interesting because upon it are set down the junctions or crossings of the rilibs and kaelibs with bungdokericks and bungdokericks, which form the okar leading to the island sought. It furnished the basis for all navigation.

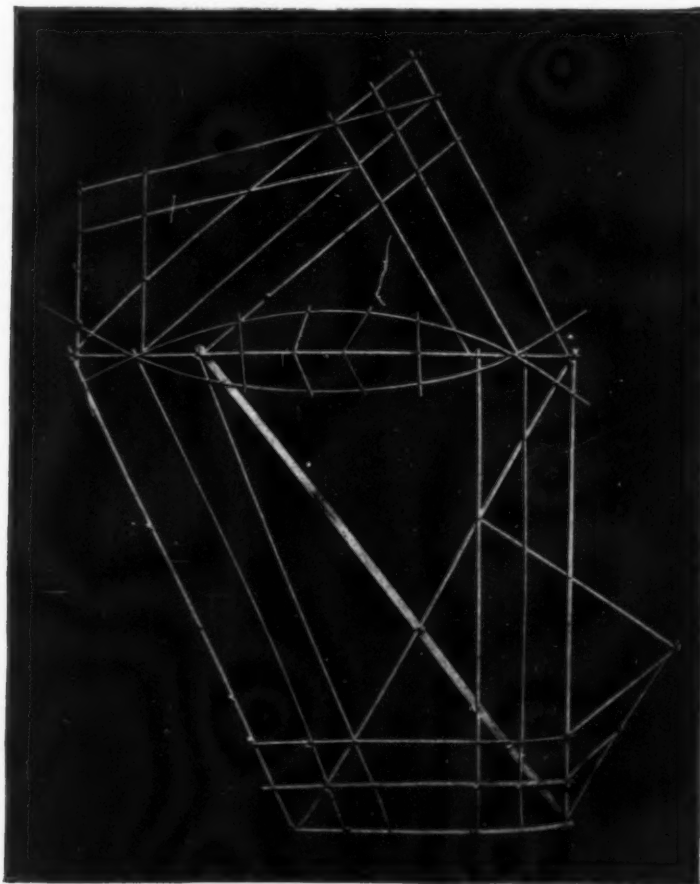
NAVIGATION IN THE MARSHALL GROUP.

The Marshall islanders are born sailors, as the position of the islands would occasion, and always practised the art of navigation extensively. Longer journeys were especially common in the Ralik chain, since its atolls and islands were all under one rule, and for that reason kept up a livelier commerce with one another. Only war expeditions were sailed from the Ralik to the Ratak groups. In the latter navigation was not so extensive, the different islands being ruled over by chiefs usually at war with one another.

To estimate the performance of the navigator, it



MEDDO IN UNITED STATES NATIONAL MUSEUM.



REBBELIB IN UNITED STATES NATIONAL MUSEUM.

must be recalled that his voyage never extends over the entire Marshall group, but is always sailed from one atoll to the next. These distances are not very great, the longest in the Ralik chain, between Jaluit and Ebon, being 85 nautical miles, that between the two chains, from Jaluit to Mille, being 120 miles.

As has been shown in describing the charts, the navigator directs his attention in the first place to the swells. Whether the stars were also consulted I have not been able to settle definitely. The different swells can be clearly seen by persons who are versed in such things, when the water is quiet, and they sail at no other times. As a rule, navigation begins at the close of June and ends when the trades set in, so that the sailing period, on the whole, covers about four months.

The month of July is favorable for voyaging, because the breadfruit begins to ripen, and is found in abundance upon all the islands. This is of importance, as they are able to carry very few provisions, the canoes being usually overcrowded with passengers. The larger canoes, which have disappeared since the introduction of schooners of European pattern, were 50 to 60 feet long and carried 40 to 50 persons. The smaller ones, carrying 10 to 15 persons, may still be seen among the islands.

The canoes consist of the hull, which is made of large pieces of breadfruit wood sewed together, and the outrigger. Between these is a platform for the passengers. The sails are made of fine mats woven from Pandanus; the cordage is made from cocoanut-palm fiber.

A flotilla consisted of from twenty-five to eighty canoes. The chiefs in piloting as a rule stayed together on one canoe, the other canoes following this. The capability of the navigator, his skill in observing the water and drawing the right conclusions therefrom, came into play, especially under unfavorable weather conditions.

METHODS OF FORECASTING THE WEATHER.*

By Prof. J. M. PERNER.

ALLOW me to-day to address you once again on the subject of weather prophets, and this time to bring before you not only one or two kinds of weather forecasting, but to give you a more general survey of all methods at present in use, be they right or wrong, with or without results. I will keep strictly to the title of this lecture and give the prominent place to the methods of forecasting. I shall explain them and subject them to critical analysis, naming at the same time the advocates of each of the various methods; in the technical investigation, we have to do with the value of the methods and not that of the persons. I must, however, at once bring prominently forward the fact that we have at present, unfortunately, no method by which we can forecast the weather with absolute certainty even for one day in advance, to say nothing of longer periods. This is already self-evident from the fact that we are now able to speak of many methods of forecasting, whereas if there were a sure and infallible method, then it would be out of place to speak of the other methods to this society for the advancement of scientific knowledge.

All methods of weather forecasting, not excepting those in use by the central meteorological offices, are based upon observed weather conditions, and have, therefore, an empirical foundation. Many of them do not even make the slightest attempt to put their methods on a theoretical basis and content themselves with setting up "weather rules." Even the scientific methods of professional meteorologists have not yet succeeded in deducing a theory capable of determining in advance the changes of the weather as the effect of one or several known causes. Only the advocates of the influence of the moon have ventured solely by means of aprioristic theories to "calculate" the weather for long periods in advance.

There are many widely different methods by which the various classes and kinds of weather prophets carry on the work of weather forecasting. There are those who make use of the behavior of animals to foretell the weather; hunters who recognize the character of the approaching season from the actions of the wild animals; the observers of birds, spiders, crickets, ants, and other animals, from whose conduct they judge of the approaching weather. But in addition to this class which utilizes living animals there is another opposing class that prefers to make use of the dead substances of the animal or vegetable kingdoms, such as hairs, strings of instruments, roots and fibers of plants; by means of their expansions or contractions, either with the aid of little weather houses and figures or without them, they recognize the coming weather. Others prefer to consult stones and walls as to the character of the weather to be expected, and turn rather to inorganic nature in order to learn from the "sweating" or dryness of these whether to expect rain or continued fine weather. Thus, as you see, all the kingdoms of nature are drawn upon to furnish prognostics of the weather, and it may depend upon the occupations and predilections of the various persons interested in the coming weather whether they give the preference to one or the other. But I had almost forgotten to mention another class—perhaps the largest—those who are not to be satisfied by any one of the three kingdoms nor even by all three together, and who rely only on their own bodies for foretelling the weather—assum-

ing, of course, that these have nerves, joints, and corns. Sometimes it is the stomach and sometimes even the head that is made use of. I am not joking in the least; on the contrary, the persons inclined to this kind of weather forecasting excite my sincere commiseration.

If these classes of weather prophets who undertake to foretell the weather by the sensations of their bodies, by observations of the animal and vegetable kingdoms, and even by the processes of inorganic nature, always rely upon facts which may have a distant connection with the weather, yet they are still far behind that class which forms its conclusions of the approaching weather from observations of the weather conditions themselves. You are all well acquainted with this latter class of weather prophets. In every community there is at least one person who is especially relied upon, whether he be a farmer, a miller, a teacher, or a pastor of long standing. They look up at the sky, observe the clouds and the direction of their motion, and from these they forecast the weather for the next day. These local weather prophets rely indeed upon phenomena which have the closest connection with the coming weather. For the weather does not spring like a *deus ex machina* down from a distant cuckoo's nest in the clouds, but is drawn from comparatively near regions, or, if you prefer, forms gradually in the place itself. This coming, this formation of the weather, is announced by the appearance of the sky, sometimes for a longer, sometimes for a shorter time in advance, and the skill of the weather prophet consists in rightly interpreting, for the near future, the appearance of the sky and the weather conditions. Since it is generally necessary in order to grasp the weather conditions correctly, to have a clear judgment founded on long experience in observing, together with an accurate eye, and, I might almost say, an inborn quickness of perception, therefore there are as a rule only single individuals in every community who enjoy the reputation of being good weather prophets. Certain phenomena, however, are of so typical a nature that they have been reduced to fixed rules and are everywhere expressed in popular language.

Thus every country has its weather signs; if the clouds are increasing, a storm or continuous bad weather is approaching. In every locality there is one direction of cloud motion that betokens bad weather, and another, generally the opposite direction, which portends fine weather, etc. Weather rules relative to the red morning and evening sky have been deduced. The rules that bad weather is expected when in any given locality the summit of a certain mountain is covered with a cap; that a small "watery" halo around the moon indicates rain; that the weather will continue bad, if when the clouds break up, a second light covering of clouds is seen above them; that it will be fine weather if, after rainy weather, according to the locality, a certain wind sets in; that a slow breaking up of the clouds gives promise of fine weather, etc.; all of these rules have been formulated from long-continued and accurate observation, and are exceedingly well adapted for local weather forecasts from one day to the next. Experienced observers also know from the color and nature of the clouds whether the prevailing weather, notwithstanding otherwise favorable indications, will continue or will change, and by these delicate distinctions they generally acquire the reputation of being especially good weather prophets.

These observations of weather signs led the way, however, to more far-reaching rules which included the attempt to determine from the weather conditions at a certain season of the year what they would be for a long series of days; or, to determine from the weather of a season, or of a certain day, or a fraction of a day, the conditions of an approaching season. Thus originated the so-called "farmer's rules," among which are some valuable ones based upon good observations extending over a hundred years, but in contrast to these there are, unfortunately, many poor ones for which we are indebted to the superficial and frivolous rules manufactured by speculating calendar makers.

Others, however, went still further and, from observing that the weather of one year resembled that of a former year, concluded that there is a certain regularity in the recurrence of years with similar characteristics, and that they were justified in enunciating the law that almost exactly the same weather returns at intervals of eleven, or of eighteen, or nineteen years, so that it would only be necessary to expect in the coming year the weather observed a certain number of years before. It is evident that this would be the simplest method for predicting the weather in any year, day by day, or at least week by week, and this is the system followed in the so-called "hundred-year calendar." Unfortunately the facts do not agree with the predictions.

Both the methods above named in general endeavor to keep one free from preconceived ideas as to causes, and base their predictions of the weather only upon earlier observations and experience, often supported by records of the weather actually prevailing, whether made with or without instruments. There are other prophets who have sought for the cause that dominates the weather and weather changes and adopting this when found have made their weather predictions in accordance with the properties, movements, and changes of this accepted cause.

This latter class, somewhat precipitately and without sufficient experience in the principles of observational work, but driven by the innate longing in the human breast to seek for a cause for all matters and supported only by general *a priori* considerations has

sought for the dominating cause of the weather. Thus, from the consideration that the sun dominates everything on the earth, Prof. Zenger has chosen that as the agent of the weather changes, which he ascribes to the rotation of the sun on its axis. Now, since the time required for a revolution of the sun occupies about twenty-six days, he has chosen one-half of the time of a revolution, that is to say twelve to thirteen days, as the period by which he measures the changes of the weather, and has arranged a weather calendar according to which there is a day of disturbance every twelve to thirteen days. In the interval between the two days of disturbance there is an interval of safety, or what he calls "calms." The comparison of the predictions of the "days of disturbance" and the "days of calms" with the weather actually occurring is supposed to give the proof of the correctness of the assumption that the semirotation of the sun governs the weather. Up to the present time, however, this has not yet been accomplished, for the attempted demonstration has entirely failed.

The method of weather predictions proposed by Prof. Servus is of a similar character; he considers the interior of the earth, and from the fact that the attraction of the earth upon the atmosphere attaches the latter to the earth, he argues that "all the great disturbances in the equilibrium of our atmosphere are caused by changes in the condition of the interior of the earth, which produce disturbances in the power of attraction." You will see at once without further explanation that this is not a tenable principle for weather predictions. Servus himself, for the purpose of preparing weather predictions, has been obliged to call in the sun and moon to his aid as causes of the disturbance in the condition of the interior of the earth. In this way his method approaches so nearly to that of Zenger and those of the lunar prophets that we need not treat of it separately.

But Prof. Lamprecht has shown us in a most startling manner how far one may be led away by adopting *a priori* causes for the changes of weather without a sufficient basis of experience. By analyzing a series of observations for several years he has discovered five periods in weather processes, one of 12.1-9 days, one of 12.23-30 days, one of 13.9-11 days, one of 14% days, and one of 29.3-7 days. Before passing on I must just tell you that one can, according to his method, compute periods of almost any length desired. This is not objectionable; but he now proceeds immediately to find the causes for these periods, which were really only computed and not at all furnished by experience, and, since he sincerely wished it, he found them. We can only be astonished at the boldness of his hypothesis. He assumes the earth to be surrounded by five rings, similar to the rings of Saturn, and that their periods of rotation and temporary relations to one another are the causes of his weather periods. Lamprecht represented to himself the existence of these imaginary rings in such a manner that he immediately endowed the rings with names, giving them successively the following magnificent names: Emperor William ring, Moltke ring, Bismarck ring, Copernicus ring, King Albert ring.

An old and by far the most widespread method of weather prediction is based on the idea, which is I might say universal among mankind,* that the heavenly bodies have an influence on everything which takes place on the earth, and particularly upon the weather. The moon is that one which was supposed to more especially influence the weather, although this power was attributed to the planets also, so that each one produces a certain kind of weather, and therefore divides the year into damp, dry, stormy, quiet periods, etc., according as one or the other planet is the "ruler for the year." The moon is credited with the principal dominator of the changes of the weather. The weather is supposed to change by preference with the moon; therefore the new moon and the full moon especially possess the power of influencing the weather, and one of the most widely spread weather rules is that the weather changes with the new moon and the full moon. However, the first and last quarters are considered of greatest importance by a great many. Especially clever observers of the influence of the moon upon the weather pretend to have also observed the distinctive individual influences of the phases known as octants. In general the opinion is very widespread that the decreasing moon exercises a weak and the increasing moon a strong influence. Thus far the theory of the influence of the moon on the weather is the direct result of the popular belief in the moon, without regard to any scientific basis.

I am not able to state whether the growth of this popular belief was preceded by observations of the weather changes, and is therefore to be regarded as a result of observations (it is not a question here as to whether the latter were defective and inconclusive or not), or whether, on the contrary, the belief in the influence of the heavenly bodies and in that of the one which, after the sun, appears the largest and most striking to mankind, namely, the moon, was the earliest step, and that it was in the light of this belief that observations were first made. At all events, the latter is far more probable than the former, and therefore I cannot put the moon theory of weather predictions in the same category as the methods mentioned in prece-

* Astrology seems to have been specially cultivated in Mesopotamia and to have been spread north, south, and west by Sanskrit, Greek, and Arab influences. It is peculiarly Asiatic and European. There is no record of its having had any great influence among the Chinese, Malays, or American Indians. It can, therefore, hardly be spoken of as universal among mankind.—ED.

* A lecture delivered by Prof. Dr. J. M. Perner to the Association for the Advancement of Scientific Knowledge, Vienna, January 14, 1905. Translated from the *Vorträge des Vereines zur Verbreitung naturwissenschaftlicher Kenntnisse in Wien*, 65d Jahrgang, Heft 14. Printed in Monthly Weather Review, U. S. Department of Agriculture.

ing paragraphs. These latter methods were certainly based on observations (we say nothing as to whether the observations were correct or not); but this is not established in regard to the belief in the moon theory; indeed, the probability is in favor of the contrary process, namely, the opinion that the moon must influence the weather came first, and observations only came later in order to see if the theory were correct.

This idea is strongly supported by the more recent development of the theory of the influence of the moon upon the weather. This newest and at the present time very prominent phase of this theory did not start by collecting reliable observational data and deducing from these observations the influence of the moon upon the weather, but first adopted the old belief in the moon and then sought to create for it a scientific basis by means of *a priori* assumptions and even theoretical mathematical explanations.

With these results, either assumed or computed, the representative of the modernized theory of the moon appears before the public and invites his contemporaries to test his "results" by observation. This process is, as you see, the exact opposite to that of the true empirical method. The empiricist makes observations, observes long and much, and sums up the general results of the observations in certain propositions or "rules," and when it is possible draws his conclusions as to the cause of the phenomena. The modern moon prophets turn the process upside down. They designate the moon beforehand as the cause of the changes of the weather; from the various positions of the moon with respect to the earth and the sun, with the assistance of the laws of attraction—without any strict investigation as to how far these can possibly be of influence—they compute the attraction exercised by the moon in its separate positions, and say on such and such a day the influence of the moon must have produced such and such a result on the weather. The confirmation of these predictions by the observations should then only show the accuracy of their assumptions and computations. The number of these modern moon prophets is at present large. Many of them take into consideration the planets in addition to the moon. The names of the most prominent advocates of these moon theories are known to you. They are as follows: Falb, Ledochowski, Gladbach, Demtschinski, Garligou-Lagrange, A. Poincaré—not the celebrated mathematician—and Digby.

It would be quite erroneous if this method of investigation into the causes of the weather were regarded as incorrect and improper. By this presentation of the subject I wish only to show that the modern moon prophets—and probably also the older ones—have not introduced strictly inductive empirical methods into their belief in the moon, but that this belief was there from the first and that they have made use of the discovery method for its confirmation, since it is on the basis of the moon theory, or, if you prefer, of *a priori* considerations as to the influence of the moon, that they make their weather predictions, and then from the agreement between these they endeavor to deduce the correctness of their assumptions. Against this method as such there is nothing to be said, but it demands the most conscientious, straightforward, logical, and accurate determination of the consequent weather if we wish by this method to arrive at a confirmation or refutation of the propositions advanced as to the influence of the moon. How this is to be managed we have still to learn; meanwhile it is at present only necessary, in this enumeration of the various methods for predicting the weather, to include that one which represents the influence of the moon.

As soon as men began to observe the barometer attentively, they began gradually to recognize that the rising and falling of the barometer had an evident connection with the weather. It was the celebrated burgomaster, Otto von Guericke, of Magdeburg, who first used the barometer as a "weather glass." He applied, even then, to his water barometer the "weather scale" which is at present in such general use, on which the highest reading occurring at any place is designated as "fine weather," the lowest reading as "rain and wind," etc. The barometer as a weather glass has taken its course throughout the world, and is to-day used almost universally. After the introduction of the aneroid barometer the "weather scale" was also affixed to that, and whoever purchases such an instrument pays particular attention to make sure that the weather scale is correctly fixed on it. The makers of these instruments must know the mean pressure at the dwelling place of the purchaser; there they place the term "changeable;" the point where the pressure is about 10 millimeters above the mean is "fine," and at about 20 millimeters above the point designated as "changeable" will be "steady," "fine," or "dry," or the like. At about the same distance below "changeable" is placed "rain" and "storm."

Whoever has provided himself with an instrument of this kind believes himself to be the possessor of a self-registering weather prophet and is generally highly indignant if it rains when his barometer stands at "fine," or astonished if it is fine weather when the barometer says "rain." Since these erroneous indications are not unusual with the barometer, therefore faith in it as an indicator of the weather is very much diminished, and is only maintained at all, on the one hand, by the fact that the barometer frequently "indicates correctly," and, on the other hand, by force of habit. Frequently, however, one has taken refuge in another instrument, namely, the hygrometer. This instrument shows only the amount of moisture actually prevailing in the air, in the same way that the barometer indicates the actually prevailing pressure. As the

pressure and the moisture are both connected with the weather, the hygrometer may be used as a weather prophet in the same way as the barometer, although that is not its real vocation. If the hygrometer shows a high degree of moisture, that only indicates that the air is just then very moist, and this generally happens only when the weather is already bad. However, it happens sometimes that the moisture in the air increases while the weather is still fine, so that the hygrometer will generally indicate dryness when the weather is fine; it will sometimes, however, when the weather is not yet fine, point to decreasing moisture, and thereby foretell approaching drier and finer weather. The best of these hygrometers are made of human hairs, divested of grease, which have the property of being expanded by dampness and contracted by dryness in a most admirable manner. This property of varying its dimensions with the changing moisture is also possessed by other animal and vegetable substances. There are a number of weather indicators of this kind, among which the little house with the little man and woman, in which the man goes out in bad weather and the woman in fine weather, is probably the best known.

The discredit into which the hygrometer as a weather prophet has often fallen is as easily understood as in the case of the barometer. Its duty is only to show the moisture actually prevailing at its locality, and this knowledge does not enable one to make determinations of the approaching weather any more accurately than does a knowledge of the pressure at any place.

A new, and we must at once say a truly empirical method of weather prediction, is that at present in use by all official central meteorological establishments in the world. This method has gradually and slowly developed according to the exact rules of investigation in scientific practical meteorology, and is still far from having reached perfection. It has developed entirely, without any addition of an *a priori* nature, out of the observations of the weather processes, and is therefore based entirely upon well-established observational data. The most fundamental of these facts is that the weather is associated with the distribution of atmospheric pressure. It has been recognized more and more clearly by experience that the weather is determined not by pressure, as shown by the barometer at the place of observation, but by the barometric conditions that prevail over vast regions; for instance, those distributed over the whole of Europe. Therefore one must chart and study the distribution of atmospheric pressure over the whole of Europe if one wishes to understand the weather actually prevailing.

It was necessary, first of all, to determine by extended observations, made as nearly simultaneous as possible, the distribution of atmospheric pressure for a definite hour, in order to perceive to what kind of weather this distribution of atmospheric pressure corresponded. It was by this means demonstrated that there is an extraordinarily great variety of forms of atmospheric pressure distribution; that these, however, can be classified into a certain number of types by having regard to the form as well as to the weather conditions given in these forms. . . . The thorough and persevering study of the weather that prevails on the occurrence of each type has led to the definite and certain recognition of the following theorems:

1. The weather, in all its details, depends upon the distribution of atmospheric pressure, and the same weather always corresponds to the same location relative to this distribution.

2. The weather of any place is, therefore, determined by its position in and relation to the various styles of pressure distribution.

3. If we succeed in knowing in advance what distribution of atmospheric pressure will prevail on a certain day or on a series of successive days or a longer season, then the weather of the day or of the period of time is thereby determined in advance.

4. The modifications introduced by reason of geographical conditions, the configuration of the ground—as, for example, the location of a place in the Alps, etc.—are constant for the location in each style of pressure distribution.

By means of these theorems, which were deduced from exact observations, the foundation was laid for a careful method of weather prediction. Two things were now necessary: (a) The perfecting of our knowledge of the typical distributions of atmospheric pressure and of the details of the weather attending them; (b) the deduction of the rules, according to which one form of distribution of pressure either remains stationary, or moves over Europe, or changes into another form, or is pushed aside by some other type.

It is in the nature of things that the first task is more easily accomplished than the second. The present state of the art of weather prediction in our central meteorological institutes corresponds to this condition of affairs. The details of the weather conditions within the various styles of pressure distribution are, on the whole, quite well known. However, there remains much to be done in this direction, and it is now one of the most important duties of meteorology to most thoroughly investigate, in all directions and details, the distribution of the weather according to the forms of pressure distribution. The knowledge of the weather conditions for every place and for every type of pressure distribution offers the only entirely satisfactory empirical basis for weather predictions; moreover, it is by this knowledge alone that we can hope at some time to discover the fundamental laws of the changes in the weather. This knowledge, however, does not lead us immediately to a prediction of the

approaching weather, but only teaches us to know the weather of one particular place when the distribution of pressure is known. In order to be able to predict the weather, we must know one thing more—we must know in advance what distribution of atmospheric pressure will prevail at the time for which we are predicting the weather. This foreknowledge of the pressure distribution is the starting point upon which the whole weather forecast depends. If this foreknowledge of the future distribution of atmospheric pressure is impossible, then weather prediction is impossible; if we can foretell it approximately, then a weather prediction of greater or less probability is possible, and we shall be able to make a larger number of correct than of incorrect predictions; if the distribution of atmospheric pressure can be known in advance with certainty, then we shall be able to make weather predictions with certainty.

Now, how do we stand as to the question of certainty in foreseeing the approaching distribution of atmospheric pressure? If we knew the laws according to which one distribution of atmospheric pressure changes over into another, or according to which it moves across Europe, as well as the laws that cause one distribution of atmospheric pressure to continue stationary or suddenly break up and another one result from it, then the problem could be solved and future weather could be predicted with entire certainty. We should proceed with mathematical accuracy in the prediction of weather, and be able to attain the correctness of the astronomers in their predictions of celestial planetary motions and phenomena. This, of course, is the ultimate aim of meteorological science, but we are at present so far removed from it that we have many well-founded doubts as to whether this object will ever be attained. Up to the present time we are only able to deduce from the experience hitherto acquired a few empirical laws of limited applicability, according to which the types of distribution of atmospheric pressure remain stationary, change, or transform themselves entirely, or perhaps move away over the earth; even this limited empirical knowledge relates almost entirely to the change from one day to the next. Since these empirical laws as to the changes in the distribution of atmospheric pressure are so defective, the difficulty of foreseeing the approaching distribution of pressure is correspondingly great, and the prediction of the weather even for the next day is proportionately unreliable. Since we have to do only with theorems founded entirely upon experience, the persons best qualified to make the predictions are those who through long years of practice have collected the most theorems as to the variations in the forms of pressure distribution, and have also learned by practice the many modifications to which these theorems are subject. In the forecasts for the next day men of much experience attain to more than 80 verifications in a total of 100 predictions; but the prediction of the distribution of pressure for more than one day in advance has such a low probability that in a forecast of the weather for several days in advance we must expect more failures than results.

You will say: "It is despairingly little that we have to expect from scientific weather predictions, and hence it is not to be wondered at that the public generally clamors for methods that promise more." It is easy to promise, but one's promise must be kept, and that is difficult. It would also be easy for scientific meteorologists to make the same promises and boastings as the other weather prophets, but they would then cease to be called scientific. And of what use is it to cling to those weather prophets who certainly promise a great deal, but finally leave you in the lurch? Of the popular methods of predicting the weather above enumerated, none accomplish nearly as much as is accomplished at present by the scientific method; indeed, very often they accomplish nothing beyond the noise they make in praising themselves. However, before I begin to criticize the various methods, I will briefly lay before you the processes adopted in weather prediction at the central meteorological stations. You know that at our central office in Vienna, for example, telegrams arrive every morning from more than 140 places over the whole of Europe; these telegrams contain the observations made that morning of pressure, temperature, moisture, precipitation, and wind. According to these telegrams the chart of the distribution of atmospheric pressure is drawn as it prevailed over Europe that morning; and from this particular style of distribution of atmospheric pressure in conjunction with that which prevailed on the preceding day, and by making use of the above-mentioned empirical laws governing the changes in the forms of the pressure areas, a tracing is made of the probable areas of atmospheric pressure for the next day. When this sketch is completed then the predictions for the various portions of the kingdom are made upon the basis of our knowledge of the weather conditions at different points of each area of atmospheric pressure. Thus the primary difficulty consists in forming a correct conception of the pressure distribution for the next day, based on that prevailing on the morning of the day in question, and at the same time a clear idea as to the velocity with which the changes will proceed. In order to facilitate this difficult task the central office receives immediately before the making of the forecast, which takes place at 1:30 P. M., a short telegram from twelve selected stations in Austria-Hungary, giving the latest information as to changes in temperature, pressure, and cloudiness that have occurred at these stations since the morning observation. From this last item we can perceive with more certainty whether we have formed a correct idea as to the distribution of

atmospheric pressure for the next day or not, and therefore whether to retain or modify the forecast. It is only after the data of the midday telegrams have been made use of that the definite forecast is made. At 1:45 P. M. the weather report goes to the printer, and the corresponding telegrams are sent to those who have subscribed for the daily telegraphic forecasts.

The results of this system of honest weather forecasts are indeed modest, but are such as to show a real and striking progress in weather predictions as compared with other methods. Of course even this earnest scientific method allows us only to consider the general characteristics of the weather, as, for example, "fine," "windy," "mild," "fine and cold," "cloudy," "rainy," "warm," etc., as the object of the weather forecast. This method would immediately supplant all others if it would undertake to foretell the duration and amount of precipitation, the degree of the thermometer, the exact force of the wind, etc. However, we may at present be very well satisfied if the general character of the weather is predicted for us. Unfortunately, even the scientific method can give no positive certainty, since even by confining itself to these general characteristics it can at present offer only a little above 80 per cent of verifications of the weather.

In this state of the case it is self-evident that our efforts are to be guided in the direction of those studies that will lead us to an ever-increasing accuracy in forecasting. These studies of course relate (1) to more and more thorough investigations of the weather conditions at every point and in every phase of the distribution of atmospheric pressure; (2) to the discovery of signs by which to form a judgment (a) as to the rapidity and paths with which each type of pressure distribution moves over Europe, (b) into what other forms a given type of distribution transforms itself and the rapidity of such change, and (c) what changes in the weather attend the various modifications of one and the same type of atmospheric pressure distribution. With the increase of our knowledge on these points the weather predictions will also become more and more accurate. However, it is very doubtful whether it will ever be possible for us to invariably attain absolute accuracy even for one day in advance. Every increase in percentage of verifications is, however, of the greatest value, especially to national economies.

Now, as a matter of course, the meteorologists are looking everywhere in order to take advantage of everything which may be of assistance to them in this matter. In the first place, there are the many good weather rules that have been deduced from the experience of many hundreds of years. But the greatest number and most valuable of these weather rules are only applicable to local weather predictions, whereas the central meteorological institutes must make their predictions for very distant countries also, as, for example, Austria for Dalmatia, Vorarlberg, Bukowina, etc.

Those weather rules, however, which relate to the weather conditions of certain definite dates, and which are generally looked upon as farmers' rules, are sometimes of great assistance in making forecasts. Thus we know that on certain dates of the year there has for centuries been a tendency to a certain kind of weather; for example, to rainy weather. Therefore, if at such periods the distribution of atmospheric pressure is of such a form that it may easily change to a type corresponding to the weather indicated by the farmers' rules, then we may be tolerably certain that we must forecast wet weather. But, on the other hand, if at some such period the distribution of pressure is of such a character as would ordinarily justify us in hoping for a change of weather, still we know that this

First and foremost, I must insist most strongly on the fact that professional meteorologists themselves have always recognized and do recognize one influence of one heavenly body as most decisive and the sole cause of the weather on our earth, viz., the heating of the earth and of its atmosphere by the sun. The sun regulates our weather; it gives rise to winter and summer; by evaporation it raises the aqueous vapor into the air, and this vapor, by cooling, produces clouds

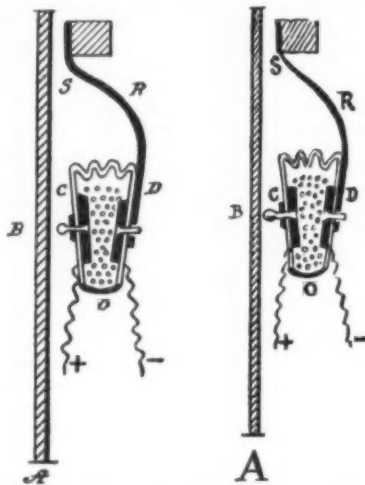


DIAGRAM SHOWING PRINCIPLE OF THE ISOPHONE.

and rain, snow, storms, and hail; it is the primary cause of the differences in atmospheric pressure, and in this way produces the winds.

This heating influence of the sun, as also its modifications by cloudiness, by the wind, by the change from day to night or from winter to summer, and by the properties of the earth's surface, which, consisting as it does of water and land either covered with vegetation or barren and bald, has varying capacities for absorbing the sun's heat—this influence of the heat of the sun has been established with the most absolute certainty by the most exact observations. It has been demonstrated to be so much more important than any other cause, if any such exists, that up to the present time it has not been possible to recognize any other cause with certainty, in spite of the fact that the professional meteorologists, and singularly enough they only, have instituted extensive and most thoroughly exact investigations in order to discover such other influences, in case there are any, and to determine their value. And what has been the result of these extraordinarily laborious and wearisome investigations? Before I answer this question I must call your attention to the fact that not one of the representatives of the theory of the influence of the moon, or of any other cosmical influence, has undertaken to give an unobjectionable rigorous demonstration of such an influence. These gentlemen content themselves with the inventive method and apply it in a very singular manner. They make their predictions for certain days and always call attention to the cases when they are successful, but never trouble themselves about the failures. Now, I beg you to observe that in every game of chance where there are but two alternatives there must occur fifty verifications out of every one hundred guesses, when a great number of guesses are made and it is all pure chance. The time at which the game of

say, even if he obtains 50 per cent of verifications—he will know that the theorem or assumption made use of as the basis of the predictions really has no causal connection with the weather. Only when more than 50 per cent of verifications are attained can the argument favor the assumption, and so much the more in proportion as the verifications exceed 50 per cent.

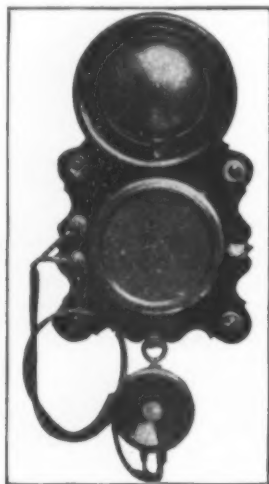
This exact method, the only one for testing their hypotheses as to the cosmical influences on the weather, is the one that has never been applied; in fact, it has often been distinctly rejected by those who maintain the existence of these influences; and yet those who make assertions should prove them. It was the professional meteorologists themselves who undertook the accurate examination of all the various cosmical hypotheses, and particularly that of the influence of the moon, and it was they who found a slight influence of the moon on storms, thunderstorms, the direction of the wind, atmospheric pressure, etc. Now, do you say, "I told you so"? Well, first of all, observe—and I cannot insist upon it too strongly—that it is the professional meteorologists, and they alone, who have made these investigations which point to a slight influence of the moon. Next, I must direct your attention to that little word "slight." The influence thus discovered by them is indeed so small that we cannot even state with certainty whether it really does exist at all; or whether, perhaps, it was only perceptible in these investigations because the period of time included in them is still too short to furnish us with an unexceptionable result. However, let us assume that this slight influence really does exist, and let us examine the amount of this influence a little more closely. Its magnitude is expressed by the percentages of the favorable cases. We will, however, for once greatly exaggerate and assume that these favorable cases amount to a surplus of 5 per cent. That is to say, that in 100 cases 55 succeed and 45 fail. Now, if you use such lunar rules for weather predictions, what does it advantage you in isolated single cases? For instance, you are in doubt as to whether the rain is to be expected or not; the influence of the moon indicates rain with a weight of 0.05. In spite of this small weight, if now you forecast bad weather, you will, if 100 such cases occur, have a failure in 45 cases. Had you paid no attention to the influence of the moon you would possibly have had fifty failures. Thus, in this case of 5 per cent of surplus, that would be the whole effect of your consideration of the moon's influence. But we have in fact assumed an exaggerated case, and the real influence of the moon is in every case less than one-half of this, if indeed it really exists at all.

You may rest assured that the professional meteorologists accept, nay, even seek for, everything that can give them any assistance whatever in their weather predictions. By constant investigation and study we may hope to advance step by step and per cent by per cent. Every single per cent of agreement that is gained is an important advance and success.

THE ISOPHONE.*

By EMILE GUARINI.

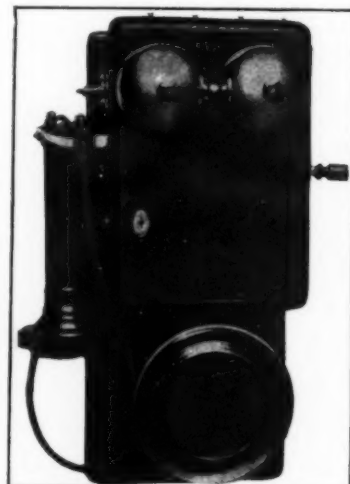
The apparatus called "isophone," which has recently been devised by M. Scheer, of Brussels, is a microphone designed to form a new and powerful telephone transmitter not liable to get out of order. Its principal advantage is that of reproducing accurately the quality of the voice, music, etc. Another important feature is its simplicity and the ease with which it can be adapted to the apparatus already in use. The apparatus, which is represented in the accompanying figures, possesses the general form of a hollow disk in which is suspended the special carbon system. The characteristics of



AN ISOPHONE STATION.



THE ISOPHONE'S INTERNAL CONSTRUCTION.



ISOPHONE WITH CALLING MAGNET.

change is not likely to occur, because there is a continued tendency at this period to wet weather, and a change of weather is not to be looked for. Such aid as this from farmers' rules is, however, of moderate value and rarely available. But it is quite otherwise, in the opinion of the believers in the moon, when we consider the support that the weather predictions might derive from the hypotheses that attribute to the moon and the rest of the heavenly bodies a decided influence on the weather. I will express myself more in detail on this subject.

chance is played, or the time when the guess is made, is absolutely without any influence whatever upon the result. So, also, the drawing out of an even or uneven number of balls could have no influence upon the weather, even if it should occur to some one always to predict fine weather when he drew an even number and bad weather when he drew an uneven one. If, therefore, one should make use of the above-mentioned inventive methods, he should carefully record all the cases—the failures as well as the verifications. And then, even if every second case is a success—that is to

the apparatus consist in the use of a movable case (containing granules or dust of carbon) made of a flexible, non-resistant material, placed in a sounding-box (i. e., in the hollow of the disk), of which the two sides are connected by a thin plate.

In this system, therefore, the carbon granules or dust are contained in a receptacle of leather, parchment or other flexible and nonresonant material. As before stated, this receptacle is movable and suspended opposite the vibrating plate, so as to receive the vibra-

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

tions of the latter through the intermedium of a small blunt point of ivory, ebonite, or other hard substance. The receptacle is hermetically closed, but its faces are provided with one or more apertures lined with rubber, which tends to put the granules back in place after the compression produced by the vibrations, and which, in all cases, favors the displacement of the granules.

The two poles end in the interior of the receptacles and are secured to two sticks of carbon that face each other, and the space between which is filled with the carbon granules that become properly placed by their own weight. This system operates regularly, is very sensitive and certain, and does away with the causes of the alteration of sounds. It prevents the granules from becoming unduly compressed by equalizing their pressure between the two sticks of carbon by their own weight.

The absence of contact with the resonant metallic parts contributes toward perfectly preserving the quality of the voice, etc., because there is no production of what is found in the carbon-metal microphone, in which the variability of the oxidation causes a variation in the resistance, just as happens in a coherer submitted to the influence of electric and sonorous waves.

In the accompanying diagram, *A* is the vibrating plate; *B* the point that transmits the vibrations of the latter to the carbon granules or dust; *C* and *D* the carbons connected with the poles of the battery and the receiver; *E* the rubber regulating part that balances the compression of the granules; *F* a piece forming a hinge at *S*, and a slight conical flexible sheath forming a bellows and containing the granules of carbon that place themselves through their own weight between the two carbons. The pressure produced upon the vibrating plate by the ivory point is obtained automatically by the weight of the receptacle charged with the other accessories. We have examined some specimens of the apparatus sent to us by the inventor and can say that no other system having the same advantages possesses so great a simplicity and can consequently be afforded at so low a price. Some experiments of short duration, moreover, have permitted us to remark two characteristics, viz., the great sensitiveness of the apparatus and the remarkable distinctness of the sounds. The isophone reproduces music (say that of the violin) perfectly, with clearness and softness and without any very appreciable difference, at a distance of from three to fifteen or more feet. Were the comparison possible, we should say that this microphone behaves somewhat as a Guarini autodecoherent coherer does with regard to electric waves. Whether it is well actuated or whether it is not, its resistance is not very different with slight waves from what it is with strong ones.

THE SCHLOEMILCH WAVE DETECTOR.*

By our Berlin Correspondent.

Most of the detectors so far used are based on the so-called coherer and anticoherer principles, in which the action of electric waves on the resistance in passing from one body to another is utilized. According as this action consists either in an increase or a decrease of the resistance, the apparatus is termed anticoherer or coherer respectively, the latter being the most usual type.

Other instruments, such as for instance the well-known Fessenden wave detector, utilize the thermic effects of electric waves and the oscillations in the resistance of bolometer wires so produced. Marconi practically applies a principle which was first suggested by Rutherford, in the form of a wave detector resembling a small magneto-electric machine with a soft-iron armature, receiving a small amount of residual magnetism at each half revolution, which through the action of the impinging electric waves is made to disappear, as may be ascertained in a conveniently arranged telephonic circuit.

None of these devices is of sufficient accuracy, apart from their limited durability and the inconvenience of using motor-driven machines, as in the case of the Marconi detector. In an apparatus first exhibited at this year's wireless telegraphy conference in Berlin, and just brought out by the Berlin Gesellschaft für Drahtlose Telegraphie, Mr. W. Schloemilch uses a novel principle, namely, the sensitiveness of polarization cells to electric waves.

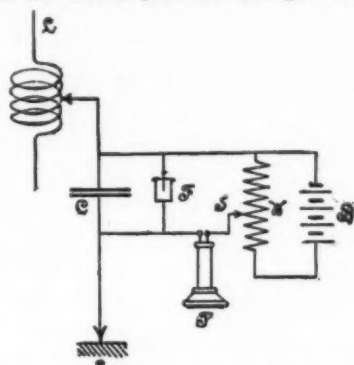
In the course of his investigations on the behavior of polarization capacities toward electric waves, the inventor noted that if an ordinary polarization cell with platinum or gold electrodes immersed in diluted acid be connected with a source of current, the electromotive force of which is a little higher than the counter E. M. F. of the cell (so as to cause a slight evolution of gas on the electrodes in virtue of a permanent decomposition current) an ammeter inserted into the circuit would give evidence of an increase in the current strength as soon as the cell was struck by an electric wave.

As this effect proved to be the higher the smaller the dimensions of the positive electrode, the definite type of apparatus contained positive electrodes 0.001 millimeter in diameter and 0.01 millimeter in length, while the negative electrodes, being of no importance, may have any desired dimensions and shape.

It is impossible, at the present moment, to determine the physical nature of the phenomenon in question, and whether the detector embodies a capacity or an ohmic resistance. There is a critical tension, different from each individual detector, for which the sensitiveness is highest. At the same time, there is a strengthened evolution of gas bubbles on the electrode as the elec-

tric waves strike the electrode; this is most strongly marked in the case of the critical tension and maximum sensitiveness. By choosing as electrode materials two metals as distant as possible in the series of tensions, so as to constitute a small galvanic cell, the auxiliary battery may even be dispensed with.

One of the most important advantages afforded by



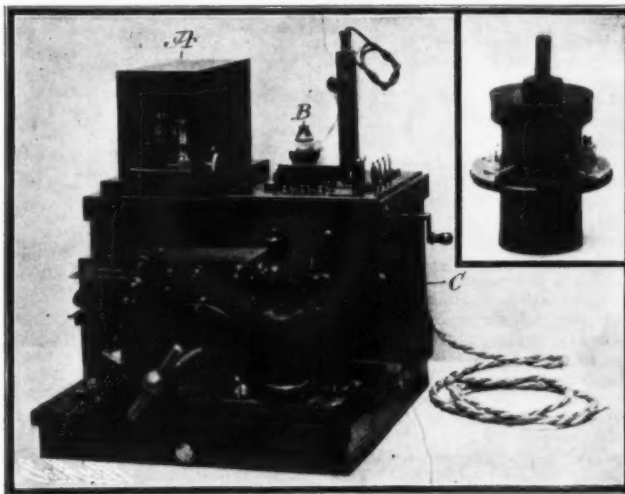
CURRENTS OF THE SCHLOEMILCH WAVE DETECTOR.

this novel wave detector is its property of reacting to wave impulses, proportionally to their intensity, thus showing a reaction even with low-tensity waves; in fact, it will never cease to work abruptly, as other types are known to do. On the other hand, the constancy and insensitiveness to shocks should be mentioned, nor should the advantage of readily regulating sensitiveness of the cell by altering the tension be omitted.

The instrument may be put to various practical and scientific applications. In virtue of its special properties, it may be used for measuring wave intensities and comparing the intensity of the radiations given off from different sending devices; moreover, the physical nature of the spark in the exciting spark gap can be ascertained by its means. On the other hand, the well-known drawback met with especially in granular coherers, viz., the liability of the instruments to become over-excited, resulting in serious disturbances, will be eliminated in the new instrument, which reacts all the more powerfully the higher the intensity of the impinging waves. Moreover, there is no necessity of using highly sensitive relays, as in the case of most of the

physical process involved in the detector action; Fessenden, however, in his barometer, which is practically identical with this cell, considers the action to be a bolometric one, the electrolyte being warmed, and the resistance thereby reduced. In the author's experiments it was found that the current when a wave arrived could easily reach ten times its normal value. Assuming even that the electrolyte (sulphuric acid here) at the small anode were warmed up to the boiling point, the resistance would, however, not sink to one-tenth its value (according to Richarz, Wied. Ann. 47, p. 579, 1892), and the following observations are held also to contradict the views of Fessenden. Using only a half-wave produced by the non-oscillatory discharge of a condenser, the discharge through the cell in one direction (small electrode anode) gives only a very small deflection on a galvanometer. With the discharge in the opposite direction the deflection is large and much greater than that obtained by discharging direct through the galvanometer. With increasing P. D. at the condenser the deflection increases, also with increase of capacity, but not proportionally; and there is a definite discharge energy which gives the greatest efficiency as regards ratio of deflection to energy of discharge. All these observations are held to point to anodic polarization, as with a bolometer effect the deflection could never have been greater through the cell than direct through the galvanometer (without cell). Curves taken with a Duddell oscillograph also bear out this view, and these are reproduced. The author considers it possible that some sort of dissolution of the anode takes place whereby oxygen disappears at the anode, as has been shown by Ruer to occur with simultaneous flow of a weak direct and alternating current. Ruer also showed that this effect of the direct current was a purely chemical oxidation. The same holds in the case of the detector, for with the aid of two additional electrodes the effect of the direct current could be assisted or weakened by development of oxygen or hydrogen just beneath the anode, and the development of hydrogen was found to be more favorable with a strong direct current, of oxygen for a weak current; and the same with strong and weak waves respectively.

RADIO-ACTIVE GAS FROM CRUDE PETROLEUM.—E. F. Burton has obtained a highly radio-active gas from petroleum obtained from a well in Petrolia, Ontario, where it occurs in the carboniferous limestone, although it probably has its origin in the underlying Trenton formation. Air was passed through the heated oil, and



THE SCHLOEMILCH WAVE DETECTOR.

other detector types, it being sufficient to note the Morse signals through the telephone.

The problem as to whether the cell constitutes a capacity or an ohmic resistance being so far unsolved, the inventor has not yet been able to establish any definite arrangement of the detector circuit. The tuning of the receiving system is, as a matter of course, susceptible of the same accuracy as in the case of other instruments. A suitable arrangement is shown in Fig. 1, where *B* is an accumulator battery, the circuit of which is permanently closed through a shunt; *F* is the detector; *T* is either a telephone or a relay; *S* is a sliding contact regulating the tension; *L* is the antenna comprising some self-inductive windings; *C* is a variable capacity inserted in parallel to the cell.

The detector, as shown in Fig. 2, is inserted in a small hard-rubber protective case. A longitudinal perforation, in connection with a tightening piece of rubber tubing at the mouth of the perforation, serves to prevent any liquid from leaking while the gases are allowed to escape freely. A view of the complete receiving apparatus is presented in Fig. 3. This form of apparatus permits the use of a relay or a telephone. Another special form of apparatus is specially designed for telephonic records.

M. Reich (Phys. Zeitschr.) refers to the Schloemilch electrolytic cell, and describes a method of making the microscopic anode, using for this purpose a fine capillary tube with a platinum wire inserted and fused in, the whole tube and wire being drawn out together at a highly heated part and the glass then broken off short. Schloemilch has given no explanation of the

then in succession through concentrated sulphuric acid, a flask surrounded by ice, phosphoric pentoxide, and glass wool. It was finally pumped into a cylindrical vessel of galvanized iron, containing an exploring rod connected to an electrometer. The cylinder was maintained at a potential of 168 volts by a battery of small storage cells, and the conductivity of the gas which it contained was determined by measuring the saturation current to the exploring electrode. On first introducing into the cylinder the air which had passed through the oil, the conductivity jumped up from 16.5 to 92 scale divisions per minute. Its conductivity steadily increased, after the cylinder was closed, for about three hours, when it reached a maximum value, after which it slowly decreased approximately in a geometrical progression with the time. This would mean, according to Rutherford's theory, that the air is charged with emanation, and its conductivity increases to a maximum, which is reached when the loss in the ionizing power due to the decay of the emanation is just equalled by the gain contributed by the excited radio-activity produced in this process of decay. From this time the rate of change indicated gives the rate of decay of the emanation. The author finds that the radio-active gas decays approximately according to an exponential law, falling to half value in 3.125 days. It produces an induced radio-activity whose rate of decay is such that it falls to half value in about 35 minutes, that being the same value as that obtained in the case of Cambridge tap-water. The author concludes that the active gas obtained from crude petroleum is very probably identical with radium em-

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT

anation, but admits that there are indications of the existence of a radio-active substance more persistent than radium emanation.—E. F. Burton, *Philosophical Magazine*, October, 1904.

IS THERE AFRICAN BLOOD IN THE WHITE RACE OF EUROPE AND AMERICA?

By O. M. PETERSON.

I.

THAT the first race of human beings was a black or dark-skinned race may be inferred from two well authenticated facts: First, that in the evolution of life upon earth man appeared at a period when the coldest place on the globe had a much warmer temperature than the hottest place at the present time; second, that the dark color of the skin is produced by the hot rays of the sun.

But the assumption that the human species was originally dark-skinned does not mean that the whole human race is descended from negroes; for even at the present time there are many dark-skinned and even black races, not only in Asia and Australia (Oceania) but even in Africa, that are not descended from the Negro race.

During the climatic changes which our earth has undergone throughout the ages, not only by the gradual cooling of its surface, but particularly by the cataclysms caused through the shifting of its center of gravity as the result of immense masses of ice, first in one polar region, then in the other, owing to the astronomical cycle called the precession of the equinoxes, the human species has been driven, if not from pole to pole, certainly from one hemisphere to the other, or from torrid to frigid regions and back again through regions of varying temperature.

There is no doubt that the present white race (many white, black, brown or variously colored races may have lived on earth and disappeared, for all we know) was evolved from an earlier dark-skinned race that had taken refuge in some northern mountain region when the greater part of the northern hemisphere was submerged in the manner just referred to, and of which traditions have been handed down through the ages as a great flood. Those who remained in that northern region for thousands of years became "bleached," while those who migrated southward gradually reverted to the original color.

That the ancestors of all African races were a white race, and that much African blood has entered the veins of the white race of Europe and America, some well-known facts, which can be explained by a well-established physiological law, seem to prove conclusively. The facts are these: Among the whites of Europe and America the majority of young children have light hair which, in a large number, becomes darker as they grow older. In many children who are born with blue eyes, the eyes become darker as the children grow older. Among the blacks of Africa most children are born almost as light-colored as white European children—often even with blue eyes and chestnut hair. (Peschel: "Races of Man.")

The law is this: "Every animal (including the human species) in its immature condition, which lasts from the fecundation of the egg to the first sexual functions, passes through all the forms which occur during the entire life of the animals of every grade beneath it." (Peschel.) Or, as stated by Marshall ("Vertebrate Embryology"): "The phases through which an animal passes in its progress from the egg to the adult . . . represent more or less closely, in more or less modified manner, the successive ancestral stages through which the present condition has been acquired."

In explanation of this law, first enunciated by Meckel in 1812, Prof. Drummond says:

"Human embryology is a condensed account, a recapitulation or epitome, of the main chapters in the Natural History of the world. . . . It is an amazing and almost incredible story. . . . Man does not only begin his earthly existence in the guise of a lower animal-embryo, but in the successive transformations of the human embryo there is reproduced before our eyes a visible, actual, physical representation of part of the life-history of the world. . . . The same processes which once took thousands of years for their consummation, are here condensed, foreshortened, concentrated into the space of weeks. . . . Through what zoological regions the embryo passes in its great ascent from the one-celled forms, one can never completely tell. The changes succeed one another with such rapidity that it is impossible at each separate stage to catch the actual likeness to other embryos. . . . By a magic which has never yet been fathomed, the hidden Potter shapes and reshapes the clay. The whole grows in size and symmetry. Resemblances to the embryos of the lower vertebrate series flash out as each new step is attained—first the resemblance of the fish, then of the amphibian, then of the reptile, last of the mammal. . . . Far ahead of all at this stage stand out three societies—the tailed catarrhine ape, the tailless catarrhine (both of which became extinct in the tertiary period), "and last, differing physically from these mainly by an enlargement of the brain and a development of the larynx, man." (H. Drummond: "The Ascent of Man.")

Just as the development of and changes in the human embryo represent part of the life-history of the world from protoplasm to man, so the development of the child from birth to maturity represents part of the racial history of mankind, and this history tells us that

"nothing authorizes us to suppose that the Negro race preceded the white and yellow races; on the contrary, facts just pointed out lead to the conclusion that the ancestors of the Negro were a race of much lighter color," and consequently a much older race. (De Quatrefages: "The Human Species.") This history also tells us in the facts just pointed out that the blonde type of the European race is the older type from which the brunette type has been derived by crossing with dark-colored races.

The facts which have led some ethnologists to suppose that the white race is descended from the black race, and others to suppose that the black race is descended from the white race, prove conclusively, however, that a commingling and intermixture of the two races have taken place at different times through the ages, and further, that the physical characteristics transmitted by the black race, when combined with the mental and moral characteristics of the white race, have made and are making this blend-race the fittest of all races for survival.

That the brunette element in the so-called white race is gradually increasing and the blonde element decreasing, may not only be inferred from the statements of ancient historians to the effect that Egypt, Greece, Italy, and western Europe were at one time inhabited by a blonde race, while blonde individuals now are more or less rare in those countries; but it also has been proved by observations in modern times. From this we are justified in concluding that the white race as such is a dying race and has been saved from extinction only by the admixture of blood from other races, particularly from the so-called black and yellow races.

II.

The most important race characteristics are supposed to be, first, the form of the head; next, in the order of their supposed importance or transmissibility, may be mentioned the color and texture of the hair, the color of the eyes and skin, stature, and physiognomy (the shape and prominence of the nose, the prominence of the cheekbones, etc.).

Classified according to these characteristics, the population of Europe may be divided into three principal groups or types, namely: a long-headed (dolichocephalic) type with light hair, blue eyes, fair skin, and tall of stature; a round- or broad-headed (brachycephalic) type with dark hair, dark eyes and skin, and somewhat shorter of stature; another long-headed type with dark hair, dark eyes and skin, and about as short as the preceding type.

The first type predominates in the north of Europe: the Scandinavian peninsula, the Danish islands, and part of North Germany; the second type predominates in the central part of Europe, particularly in the mountain regions, and therefore has been called the "Alpine" type; the third type predominates in the south of Europe: the Spanish peninsula and the southern part of the Italian peninsula.

Tribes of the white race seem to have emigrated at different times from some part of central Asia, the earliest migrations having taken place thousands of years ago. The first emigrants seem to have taken a southerly course and settled in North Africa; later emigrants settled in Asia Minor and Greece and farther southwest along the Mediterranean coast in Europe, while still later immigrants poured into northern and western Europe.

Between the earlier immigrations of the long-headed, fair-skinned, blue-eyed race into southern and southwestern Europe, and the later immigrations, an entirely different race, a broad-headed (brachycephalic) race appears to have invaded the continent and, by overwhelming numbers, to have displaced the long-headed race to some extent. This invasion probably lasted thousands of years, during which a considerable commingling of the two races must have taken place, whereby a new race was evolved—a race which lost many of the physical characteristics of both its component elements, while preserving others; for a majority of its members have retained the broad skull of the Mongolian race to the present day, while a minority have inherited the oblong skull of the Mediterranean race.

When the later invasions into Europe of the long-headed, fair-skinned, blue-eyed race commenced, they encountered, in the west and north, tribes of this broad-headed and more or less mixed race. The invaders being a more warlike race than the occupants of the soil, these were driven into inhospitable and almost inaccessible parts of the country—the mountains of central Europe, the forests and highlands of Great Britain, the bogs of Ireland, the heaths of Jutland, and the barren coasts of western Norway. In the south the invaders encountered the more civilized descendants of earlier immigrants of their own race—the numerous, more or less Africanized, Mediterranean races, rather loosely held together under the name of Romans.

This "Great Migration," as historians have styled this invasion, commenced one or two hundred years before the beginning of our era, and has continued ever since with longer or shorter interruptions—the discovery of America giving it a new impetus, though of comparatively insignificant dimensions until the last hundred years or so, during which European immigration into this country has increased from a few thousands a year to between 500,000 and 1,000,000 a year during the last two decades.

III.

When the white race first made its appearance on the shores of the Mediterranean it was a comparative-

ly pure race—purer than the present Teutonic branch of it. The earliest description we have of the Egyptians is that of a tall, blonde race; so of the old Greeks and Romans and Kelts. In the Egyptians and other North-Africans, Greeks, and Romans (Italians) these characteristics have practically entirely disappeared, and in the Kelts, still inhabiting a large part of southwestern continental Europe, parts of Great Britain, and almost the whole of Ireland, largely so.

How was this change in physical appearance brought about? Certainly not in any considerable degree through climatic influences or a different mode of living. The explanation is undoubtedly this: the pure white race had reached the highest point of its physical evolution about the time it first arrived in Europe; but it was saved from decay and gradual extinction by absorbing and assimilating the aboriginal races with which it came in contact—by a steady infiltration of blood from the black or dark races of Africa, and by constant intermixture among its own diverse elements. From the intermixture of the white race with the aboriginal races sprang the present broad-headed race of central and western Europe; from the intermixture of the white race with African races sprang the Mediterranean race inhabiting most of the countries on both sides of the Mediterranean Sea (in Africa as well as in Europe).

The physical characteristics of the population of Europe south of the Alps and Pyrenees are so thoroughly African that it truly has been said: "Beyond the Pyrenees begins Africa." Nevertheless this Mediterranean race is essentially a white race—European in every respect except in color, which is pure brunette, though blonde individuals are occasionally met with, not only in Spain and Italy, but also in Morocco, especially along the Mediterranean coast and in the Atlas Mountains, where a very large percentage of the population are said to be blonde.

Here two questions arise, namely: 1. Has the Mediterranean race absorbed any considerable quantity of blood from the older inhabitants of Africa, now living principally south of Sahara and generally referred to as Negro races? 2. Have other European races commingled in any considerable degree with the Mediterranean race?

Travelers inform us that the intermixture of races in Africa is so great that it is almost impossible to tell where the so-called Mediterranean race ends and the true Negro race begins. (Peschel.) As the Negro skull is oblong (dolichocephalic) like that of the North-Africans and Europeans (except those of "Alpine" and Mongoloid blood), this most persistent race characteristic affords no guide in deciding these questions; but the hair and nose of the Negro are almost equally good race characteristics, and both are sufficiently in evidence in the Mediterranean race both in Africa and in Europe, particularly on the large islands in the Mediterranean Sea, to warrant the assertion that this race in the course of ages has received a considerable infiltration of Negro blood, and certainly owes to a great extent, if not altogether, the color and texture of its hair and the color of its eyes to this intermixture.

Has the Mediterranean race transmitted these characteristics to the rest of the population of Europe? To this question may be replied that though the Alps and Pyrenees have formed a barrier between the Mediterranean race and the other European races, there is plenty of evidence showing that such an intermixture of blood has taken place during the ages; in fact the earliest inhabitants of Europe as far north as Scandinavia and as far west as Great Britain are supposed to have been members of this long-headed Mediterranean race which, north of the Alps and Pyrenees, was almost completely absorbed and assimilated by the later immigrants.

IV.

That Europe has been inhabited by a long-headed (dolichocephalic) race ever since the country became an inhabitable abode for man, that is, since the gradual disappearance of the glacial ice which for ages covered the whole continent and has not yet quite disappeared from the mountain regions of Switzerland and Scandinavia, has been abundantly proved by the discovery of numerous skulls in the long-barrows of Great Britain, in the kitchen-middens of Denmark, southern Scandinavia, and northern Germany, and in the caves of southern France and elsewhere.

As these parts of Europe are still inhabited by long-headed people, as well as by others, the question arises, whether the present long-headed inhabitants are direct descendants of those "old settlers" or of later long-headed immigrants. It already has been pointed out that the long-headed people of southern Europe are of the brunette type with a very small sprinkling of blonde individuals, while the long-headed people of northern Europe are of the blonde type, but with a large admixture of brunette individuals. Now, as a commingling of the blonde, long-headed type and the brunette broad-headed race almost invariably results in a broad-headed progeny we may reasonably take it for granted that when we meet long-headed people in northern Europe with dark hair and eyes they are either direct descendants of this early long-headed stock or of later immigrants of the Mediterranean stock. But this really amounts to the same thing as far as blood is concerned, as there is no doubt that this early long-headed stock of northern and western Europe belonged to the Mediterranean race. We therefore seem justified in asserting that all brunette long-headed people belong to the Mediterranean race, which,

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

as we have seen, is a white race (the same race as the blonde long-headed race) with more or less admixture of dark blood which during ages has infiltrated from the black or Negro races of central and southern Africa.

How much of this black blood has entered the veins of the broad-headed brunette race of Europe, is impossible to tell; but from the fact that the brunette long-headed race of southern Europe not only is holding its own but gradually has been displacing the broad-headed race in many parts of central Europe we undoubtedly are justified in concluding that the brunette long-headed race, with its admixture of black blood, will ultimately displace not only the blonde long-headed race, but the brunette broad-headed race as well. The future belongs, not to the black race as such, but to a white race saved from extinction by the black blood assimilated by it—a race possessing the vital force and many of the physical characteristics of the black race, and the mental and moral qualities of the white race; the constantly increasing brunette long-headed race of Europe and North America.

Besides what may be called the natural or inherent tendency toward the increase of the brunette long-headed race at the expense both of the blonde long-headed race and of the broad-headed race, there are now two other tendencies at work accelerating this increase, namely, the constant emigration of large numbers of the Mediterranean race to western Europe and to America, and the presence of a large Negro population in this country.

ELECTRICAL NOTES.

St. Catherine's Lighthouse, situated on the south coast of the Isle of Wight, has just been provided with a new light of 15,000,000 candle-power, as against 3,600,000 obtained with the old apparatus. Seen from the land there are three distinct beams of light revolving in view, one just on the point of disappearing behind the "blank" or shield, while the others pass rapidly over the waters of the English Channel. The whole of the revolving part floats in a trough of mercury, instead of being on rollers, which has hitherto been usual, about 816 pounds of mercury being required to float it. Hitherto chain has been used in lighthouses for suspending the weights, but in this case a fine steel cable, about one-fourth inch in diameter, has been adopted.

The subject of wireless telegraphy has come up for discussion in the Cabinet of the United States. The administration's views have been embodied in a bill drafted by the Commissioner of Navigation, assisted by Capt. Seabury, of the navy, and others. The bill provides that no person or corporation shall use any apparatus for wireless telegraphy in this country or upon any American vessel, unless he be licensed by the Secretary of Commerce and Labor. Persons exchanging messages or signals between points situated in the same State or on behalf of the American government are to be exempt from this requirement. The official license is to provide that the President of the United States in time of war or public peril may close any wireless station, or authorize its use by the government. The President receives power to establish regulations which shall prevent interference between the naval and military wireless telegraph stations and private or commercial stations. Each licensed station is to be required to answer calls and signals from any other licensed station and to receive all such messages or signals offered for transmission to a neighboring station, the rate to be that customarily required for such service. This requirement is to be observed regardless of the system used, on pain of revocation of the license. Operation of any apparatus for wireless telegraphy on a foreign ship, while that ship is in American waters, shall be in accordance with the regulations prescribed by law. Government stations are prohibited from competing for commercial messages with licensed wireless stations.

In his **Cantor lectures**, in 1892, on the "Development of Electrical Distribution," Prof. George Forbes stated that if all the refuse then collected in Paddington were properly burnt and used in the most economical way, it would provide enough electricity to light one 8-candle-power lamp for two hours every night of the year for each of the inhabitants. This is referred to in the Builder, in connection with a paper read by Mr. W. P. Adams to the Institution of Electrical Engineers, on the question of the combination of dust-destructors with electricity works. We learn from this paper that the results obtained at Hackney and Fulham practically do all that Prof. Forbes prophesied, and in a few years even better results will be obtained. Mr. Adams calculates that approximately one million tons of refuse are collected every year in London, most of which is taken out to sea by barges at considerable expense to the ratepayer. On a moderate estimate, the value of the potential capacity of this refuse for steam raising for electric engines is £100,000 per annum. The author shows that, with the improved dust-destructors now in use, there is a substantial gain, in most cases, in combining dust-destructor and electricity works. The exceptional cases are when the refuse has a very low calorific value. At Llandudno and at Royton, in Lancashire, for example, the refuse is of little use for steam raising. It is curious to note that the dust of the greatest calorific value comes from poor neighborhoods. At Bermondsey its value is particularly high. Mr. Adams suggests that the explanation is that the working classes, unlike the middle classes, rarely sift their ashes. In considering the question of dust-destructors, the first point to be settled by municipalities, therefore, is the heating

value of the refuse collected. This can be determined experimentally without much difficulty, and the value remains wonderfully constant in a given neighborhood. The revenue earned by a dust-destructor is due mainly to the supply of steam to the electricity works, but this steam can be sold for many other purposes as well.

ENGINEERING NOTES.

In the paper "The Development and Use of High Speed Steel," read by Mr. J. M. Gledhill before the Iron and Steel Institute, it was intimated that the famous Damascus steel of antiquity, to which marvelous cutting powers have been attributed, is really a form of high-speed steel, containing as it does those alloys which have been found necessary in the manufacture of our modern product. He states that Damascus steel contains certain percentages of tungsten, nickel, manganese, etc., and hence a latent high-speed steel may be said to have existed centuries ago. All that was necessary to bring out its inherent powers was a very high temperature, such as was long thought to destroy its nature, in other words, "burn."

A Scotsman named Neilson, who has been resident for some time in Italy, is said to have discovered an obliging microbe, hitherto unknown, which devours all zymotic germs in sewage, and when it has completed its task dies and dissolves. Mr. Neilson is said to have invented an automatic biological tank, applicable to dwelling houses of any description, wherein his microbe disports itself by transforming the sewage into odorless, colorless liquid which is perfectly innocuous to human life, and may therefore be safely permitted to flow off into street drains, and thence into rivers. This transformed liquid has been subjected to the public analyst by order of the Commune of Florence, and it is pronounced to be "clear water, but undrinkable."

In the course of the discussion on steam turbines at the recent meeting of the American Street Railway Association at St. Louis, Mr. C. O. Mailloux stated that in Berlin there is a triple-expansion, four-cylinder reciprocating engine of 5,000 horse-power, which in running at very nearly full load has developed 1 horse-power-hour for something less than 9 pounds of water per 1 horse-power, with superheat up to 600 deg. This is possibly the best on record in steam engineering practice. However, this engine has sixteen valves, complicated mechanism, and requires a great deal of lubrication, wherefore the cost of attention, maintenance, lubrication, etc., may make it really less economical in total cost than some other engines using more steam.

A railway museum may be formed as a result of the St. Louis exhibition, the large historical locomotive collection of the Baltimore and Ohio Railway and other exhibits forming the nucleus. The historical collection referred to was exhibited at the Columbian Exhibition at Chicago in 1893 and afterward presented to the Field Columbian Museum at Chicago, which was established as an outcome of the exhibition. This institution, however, has practically decided to confine its scope to pure science, and the applied science section may be abolished. The disposal of the Baltimore and Ohio Railway collection is at present uncertain, but the establishment of a railway museum at Philadelphia has been proposed, and a large building has been offered for the purpose.

Prof. Bach recently made some experiments to determine the effect of high temperature on the strength of steel. The tests were made on groups of four bars each. The first four were tested at ordinary temperature, and the other lots at 390, 570, 750, 930 and 1,020 deg. F. respectively. At ordinary temperature the tensile strength of one bar was 54,000 pounds per square inch and the elongation 26.3 per cent. The tests on the successive lots showed that the strength increased with the temperature up to 750 deg. F., at which the total increase was about 6,300 pounds per square inch, but above this temperature the strength decreased directly with the temperature, and was found to be only 26,000 pounds per square inch at 1,020 deg. F. As a result of these tests the professor thinks that boiler steel plate should also be tested at higher temperatures than normal, as there are surprising variations from the results of tests made at ordinary temperatures.

On April 1, 1904, the German empire possessed 1,011 ships, of an average capacity of over 1,000 tons each, against 976 ships of 1,000 tons in 1903. Of these ships, 786 were steamers and 225 sailing vessels. The increase in number occurred in steamers. Germany has only 10 fast steamers; four, the "Fürst Bismarck," "Augusta Victoria," "Columbia," and "Kaiserin Maria Teresa," have been sold to Russia. Of the foregoing, 33 steamers carried the post; the others were passenger and freight steamers. In regard to size, the "Kaiser Wilhelm II.," of the North German Lloyd, with its 20,000 tons, led. There are two steamers now in course of construction for the Hamburg-American line which will be even larger than the "Kaiser Wilhelm II." One of these, the "America," is being built in Ireland, and the other, the "Europa," in the shipyard of Stettin. Of the number of ships in the Hamburg-American line there are 128 steamers. The North German Lloyd has 97 steamers; the Hansa, in Bremen, 42; the German Levant line, 30; the Wormann line, 29; the Hamburg-South American Steamship Company, 28; the Cosmos, 26, and the German-Australian Steamship Company, 25. There were 47 new steamers in course of construction in April, 1904. Of these, 13 were for the Hamburg-American line, 3 for the North German Lloyd, 6 for

the Hansa, and 7 for the firm of H. C. Hahn and Schleswig. In the matter of sailing vessels, it is noticeable that the number is not increasing, but that there is a tendency to increase their tonnage capacity.—United States Consular Report.

SCIENCE NOTES.

G. Weiss and L. Bull have endeavored to obtain a photographic record of N-rays by a novel method, but without success. They produced an image of a piece of cardboard in an ordinary camera, but did not focus it sharply in order to avoid the grain of the card. They reversed the plate in the slide, so as to receive this image through the glass. They then substituted for the usual back of the slide a backing consisting of a few sheets of black paper and a plate of lead with two holes bored through it. N-rays from a Nernst lamp were passed through these holes, in the expectation that on impinging upon the gelatine film they would reinforce the image at the two holes, and that this reinforcement of the brightness would also result in a reinforcement of the photographic image. This, however, was not the case. Exposures were made varying from 20 seconds to five minutes, but the photographic image of the card was always uniform.

Jean Mascart reports upon some pendulums made by Henri Lepaute for the Nice Observatory. They are of Guillaumes invar steel, and provided with Lippmann's electric driving gear. The extremely small coefficient of thermal expansion permits of a simple form of compensation, which in these pendulums takes the shape of a brass cylinder sliding on the steel rod. The magnets are so placed that the impulse is given at the center of percussion. The suspension is of the flexible type. The pendulums have a rate of about two seconds per day. To construct such pendulums on a large scale for railway stations would require the analysis of the materials and the elaborate calculation of all their constants, but the main difficulty lies in the calculation of the influence of the flexible support. The author is, however, of opinion that it would be quite feasible to construct a less elaborate pattern keeping correct time to within one second per day, which may be easily corrected by moving the counter without stopping the pendulum.

The experiments made by Marcel Guedras, of Paris, show that acetylene can be used as an explosive in place of dynamite, for mines or in case of war. The explosion takes place in an air chamber by means of an electric fuse. The carbide is granulated and charged in a special form of cartridge. This consists of a sheet iron cylinder, and the carbide is placed on the bottom, while above it and separated by a membrane, is a charge of water, then comes a hollow place for the electric fuse. On the side of the cartridge is placed an iron rod which forms the striker. It pierces the membrane and allows the water to reach the carbide. For coal mine explosion, for instance, the hole is drilled as usual and the cartridge run in. The opening is closed by a wood stopper. By striking on the rod, which projects out of the hole, the acetylene is given off and mixes with the air in the cartridge and in the hole. After leaving for five minutes to allow the gas to accumulate, the current is sent into the electric fuse. This causes an explosion, but contrary to what might be expected, there is no projection of rock, but it is only crevassed. It is then easy to take it down by the pick. The charge of carbide M. Guedras used is 50 grammes (750 grains) which gives 15 liters of acetylene. He thinks the above principle could be applied in military work.

The recent developments of astrophysical research have shown the necessity of constructing horizontal reflecting telescopes of great focal length, especially for photographic observations of the sun. The most serious difficulty in accomplishing this appears to lie in the fact that the form of the mirrors employed in the cœlost telescope changes through the expansion caused by the sun's heat. This tends to injure the definition of the solar image, and thus to prevent the accomplishment of the highest class of work. In 1903 Dr. Elihu Thompson suggested that if the mirrors could be made of fused quartz the difficulty should practically disappear, since the expansion of fused quartz by heat is only about one-tenth that of glass. A grant made by the Carnegie Institution permitted experiments in this direction to be undertaken, with the advice and co-operation of Dr. Thompson. The immediate supervision of the work was intrusted to Prof. G. W. Ritchey, superintendent of instrument construction at the Yerkes Observatory. After it had been decided to erect the Snow telescope on Mount Wilson, it became necessary for Prof. Ritchey to accompany the expedition to California, in order that he might take charge of the construction of the new instruments required in the investigation. It was therefore decided to make the quartz experiments in Pasadena, where the Edison Electric Company kindly offered suitable space in its power house. After consultation with Dr. Thompson, who had made important preliminary experiments with fused quartz at Lynn, Prof. Ritchey was fortunate enough to secure the assistance of Mr. Acheson, of the Acheson Graphite Company, and Mr. Tone, of the Carborundum Company, at Niagara Falls, in designing a special electric furnace for fusing the quartz. This is now under construction at Pasadena. A 50-kilowatt transformer, giving from 15 to 30 volts, has been completed, and an optical pyrometer for the measurement of the temperature of the fused quartz has been kindly loaned by Dr. S. W. Stratton, Director of the Bureau of Standards.

TRADE NOTES AND RECIPES.

Oil for Arms.—Either pure vaseline oil, white, 0.870, or else pure white bone oil, proof to cold, is employed for this purpose, since these two oils are not only free from acid, but do not oxidize or resinify.—Der Chemisch-Technische Fabrikant.

Doping.—Under this name a preparation is offered for sale which is said to impart to race horses greater speed and endurance. It consists of strychnia arseniate 0.25, caffeine 0.5, and cocaine sulphate 1 per dosis. This mixture is inserted into the interior of a carrot, and the latter administered to the horse about three-quarters of an hour before the race.—Pharmaceutische Zeitung.

Protecting Boiler Plates from Scale.—A paint for protecting boiler plates from scale, and patented in Germany, is composed of 10 pounds each of train oil, horse fat, paraffin, and of finely-ground zinc white. To this mixture is added 40 pounds of graphite and 10 pounds of soot made together into a paste with a gallon and a half of water and about a pound of carbolic acid. The horse fat and zinc oxide make a difficultly fusible soap, which adheres strongly to the plates, and binds the graphite and the soot. The paraffin prevents the water from penetrating the coats. The scale which forms on this application can be detached, it is said, with a wooden mallet, without injuring the paint.—Chemiker Zeitung.

Quick-Drying Enamel Colors.—Enamel colors which dry quickly, but remain elastic so that applied on tin they will stand stamping without cracking off, can be produced as follows:

In a closed stirrer or rolling cask place 21.5 kilos of finely powdered pale French rosin, 24½ kilos of Manila copal as well as 35 kilos of denaturated spirit (95 per cent), causing the cask or the stirrer to rotate until all the gum has completely dissolved, which, according to the temperature of the room in which the stirrer is and the hardness of the gums, requires 24 to 48 hours. When the gums are entirely dissolved add to the mixture a solution of 21½ kilos of Venice oil turpentine in 0.025 kilo of denaturated spirit of 95 per cent, allowing the stirrer to run another 2 to 3 hours. For the purpose of removing any impurities present or any undissolved resin from the varnish, it is poured through a hair sieve or through a threefold layer of fine muslin (organdie) into suitable tin vessels or zinc-lined barrels for further clarification. After 10 to 14 days the varnish is ready for use. By grinding this varnish with the corresponding dry pigments the desired shades of color may be obtained; but it is well to remark that chemically pure zinc white cannot be used with advantage because it thickens and loses its covering power. The grinding is best carried out twice on an ordinary funnel mill. Following are some receipts:

1. Enamel White.—Lithopone 2 kilos, white lead, purest, ½ kilo, varnish 20 kilos.
2. Enamel Black.—Ivory black 2 kilos, Paris blue 0.01 kilo, varnish 23 kilos.
3. Pale Gray.—Graphite 2 kilos, ultramarine 0.01 kilo, lithopone 40 kilos, varnish 100 kilos.
4. Dark Gray.—Graphite 3 kilos, ivory black 2 kilos, lithopone 40 kilos, varnish 110 kilos.
5. Chrome Yellow, Pale.—Chrome yellow 2 kilos, lithopone, 2 kilos, varnish 40 kilos, benzine 1½ kilos.
6. Chrome Yellow, Dark.—Chrome yellow, dark, 2 kilos, chrome orange ¼ kilo, lithopone 1 kilo, varnish 35 kilos, benzine 1 kilo.
7. Pink, Pale.—Carmine ½ kilo, lithopone 15 kilos, varnish 40 kilos, benzine 1½ kilos.
8. Pink, Dark.—Carmine ½ kilo, Turkey red 1 kilo, lithopone 15 kilos, varnish 40 kilos.
9. Turkey Red.—Turkey red, pale, 2 kilos, lithopone 1 kilo, Turkey red, dark, 1 kilo, white lead, pure, ½ kilo, varnish 18 kilos, benzine ½ kilo.
10. Flesh Tint.—Chrome yellow, pale, 1½ kilos, graphite ¼ kilo, lithopone 15 kilos, Turkey red, pale, 2 kilos, varnish 42 kilos, benzine ½ kilo.
11. Carmine Red.—Lead sulphate 5 kilos, Turkey red, pale, 6 kilos, carmine 1½ kilos, orange minium 3 kilos, vermilion 2 kilos, varnish 50 kilos, benzine 1½ kilos.
12. Sky Blue.—Ultramarine 5 kilos, lithopone 5 kilos, ultramarine green 0.05 kilo, varnish 30 kilos, benzine 1 kilo.
13. Ultramarine.—Ultra blue 5 kilos, varnish 12 kilos, benzine ½ kilo.
14. Violet.—Ultramarine, with red tinge, 10 kilos, carmine 0.5 kilo, varnish 25 kilos.
15. Azure.—Paris blue 10 kilos, lithopone 100 kilos, varnish 300 kilos.
16. Leaf Green.—Chrome green, pale, 5 kilos, varnish 25 kilos, benzine ½ kilo.
17. Silk Green.—Silk green 10 kilos, chrome yellow, pale, ½ kilo, lead sulphate 5 kilos, varnish 30 kilos, benzine ½ kilo.
18. Brown.—English red 10 kilos, ocher, light, 3 kilos, varnish 30 kilos, benzine ½ kilo.
19. Ocher.—French ocher 10 kilos, chrome yellow, dark, ½ kilo, varnish 30 kilos, benzine ½ kilo.
20. Chocolate.—Umber 10 kilos, Florentine lake ¼ kilo, varnish 25 kilos, benzine ½ kilo.
21. Terra Cotta.—Chrome yellow, pale, 10 kilos, Turkey red, dark, 3 kilos, varnish 35 kilos.
22. Olive, Greenish.—French ocher 5 kilos, Paris blue ½ kilo, graphite ½ kilo, varnish 25 kilos, lithopone 5 kilos.
- 23.—Olive, Brownish.—Chrome orange 5 kilos, Paris blue 2 kilos, lead sulphate 10 kilos, English red 1 kilo, varnish 40 kilos, benzine 1½ kilos.
24. Olive, Reddish.—Turkey red, dark, 75 kilos, sap green 75 kilos, ocher, pale, 5 kilos, varnish 300 kilos, benzine 1½ kilos.—Farben Zeitung.

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